Please amend the paragraph beginning in Column 2, line 3 as follows:

Such a common terrestrial HDTV system offers an HDTV service on conventional 16 or 32 QAM signals without any modification. In any analogue TV broadcast service, there are developed a lot of signal attenuating or shadow regions within its service area due to structural obstacles, geographical inconveniences, or signal interference from a neighbor station. When the TV signal is an analogue [from] <u>form</u>, it can be intercepted more or less at such signal attenuating regions although its reproduced picture is low in quality. If <u>the</u> TV signal is a digital form, it can rarely be reproduced at an acceptable level within the regions. This disadvantage is critically hostile to the development of any digital TV system.

Please amend the paragraph beginning in Column 2, line 16 as follows:

It is an object of the present invention, for solving the foregoing disadvantages, to provide a communication system arranged for compatible use for both the existing NTSC and newly introduced HDTV broadcast services, particularly via satellite and also, for minimizing signal attenuating or shadow region of its service area on the [grounds] <u>ground</u>.

Please amend the paragraph beginning in Column 2, line 47 as follows:

At the p-bit demodulator circuit, p>m, of the receiver, the first data stream of the transmission signal [if] <u>is</u> first demodulated through dividing p signal points in a signal space diagram into n signal point groups. Then, the second data stream is demodulated through assigning p/n values to p/n signal points of each corresponding signal point group for reconstruction of both the first and second data streams. If the receiver is at P=n, the n signal point groups are reclaimed and assigned the n values for demodulation and reconstruction of the first data stream.

Please amend the paragraph beginning in Column 3, line 9 as follows:

More specifically, the communication system of the present invention comprises: a transmitter having a signal input circuit, a modulator circuit for producing m signal [point,] <u>points</u> in a signal vector field through modulation of a plurality of out-of-phase carrier waves using an input signal

supplied from the input, and a transmitter circuit for transmitting a resultant modulated signal, in which the main procedure includes receiving an input signal containing a first data stream of n values and a second data stream, dividing the m signal points of the signal into n signal point groups, assigning the n values of the first data stream to the n signal point groups respectively, assigning data of the second data stream to signal points of each signal point group respectively, and transmitting the resultant modulated signal; and a receiver having an input circuit for receiving the modulated signal, a demodulator circuit for demodulating p signal points of a QAM carrier wave, and an output circuit, in which the main procedure includes dividing the p signal points into n signal point groups, demodulating the first data stream of which n values are assigned to the n signal point groups respectively, and demodulating the second data stream of which p/n values are assigned to p/n signal points of each signal point group respectively. For example, a transmitter produces a modified m-bit QAM signal of which first, second, and third data streams, each carrying n values, are assigned to relevant signal point groups with a modulator. The signal can be intercepted and the first data stream only reproduced by a first receiver, both the first and second data streams can be reproduced by a second receiver, and all the first, second, and third streams can be reproduced by a third receiver.

Please amend the paragraph beginning in Column 7, line 21 as follows:

FIG. 87 is a block diagram of a [transmission] <u>transmitter</u> of the second embodiment;

Please amend the paragraph beginning in Column 7, line 50 as follows:

FIG. 101 is a graphic diagram showing the relationship between C/N and error [rake] <u>rate</u> according to the third embodiment;

Please amend the paragraph beginning in Column 9, line 31 as follows:

FIG. 132 is a view showing a recording format of track on the magnetic tape and a [travelling] <u>traveling</u> of a head;

Please amend the paragraph beginning in Column 12, line 42 as follows:

The transmission signal is then sent down through three downlinks 21, [32] <u>31</u>, and 41 to a first 23, a second 33, and a third receiver 43 respectively. In the first receiver 23, the signal intercepted by an antenna 22 is fed through an input unit 24 to a demodulator 25 where its first data stream only is demodulated, while the second and third data streams are not recovered, before being transmitted further from an output unit 26.

Please amend the paragraph beginning in Column 13, line 13 as follows:

The NTSC TV signal is intercepted by a receiver accompanied by a small antenna for demodulation of small-sized data; the HDTV signal is intercepted by a receiver accompanied by a medium antenna for demodulation of medium-sized data, and the super HDTV signal is intercepted by a receiver accompanied by a large antenna for demodulation of large-sized data. Also, as illustrated in FIG. 1, a digital NTSC TV signal containing only the first data stream for digital NTSC TV broadcasting service is fed to a digital transmitter 51 where it is received by an input unit 52 and modulated by a [demodulator] <u>modulator</u> 54 before being transmitted further from a transmitter unit 55. The [demodulated] <u>modulated</u> signal is then sent up from an antenna 56 through an uplink 57 to the satellite 10 which in turn transmits the same through a downlink 58 to the first receiver 23 on the ground.

Please amend the paragraph beginning in Column 13, line 43 as follows:

Assuming that the input signal is a video signal, its low frequency band component is assigned to the first data stream, its high frequency band component to the second data stream, its super-high frequency band component to the third data stream. The three different frequency band signals are fed to a modulator input 61 of the modulator 4. Here, a signal point shifting circuit 67 shifts the positions of the signal points according to an externally given signal. The modulator 4 is arranged for amplitude modulation on two 90°-out-of phase carriers respectively which are then combined into a multiple QAM signal. More specifically, the signal from the modulator input 61 is fed to both a first AM modulator [64] <u>62</u> and a second AM modulator 63. Also, a carrier wave of $\cos(2\pi fct)$ produced

by a carrier generator 64 is directly fed to the first AM modulator [64] 62 and also, to a $\pi/2$ phase shifter 66 where it is 90° shifted in phase to a $\sin(2\pi fct)$ form prior to being transmitted to the second AM modulator 63. The two amplitude modulated signals from the first and second AM modulators [64] 62, 63 are combined by a summer 65 into a transmission signal which is then transferred to the transmitter unit 5 for output. The procedure is well known and will not be further explained.

Please amend the paragraph beginning in Column 13, line 65 as follows:

The QAM signal will now be described in a common 4x4 or 16 state constellation referring to the first quadrant of a space diagram in FIG. 3. The output signal of the modulator 4 is expressed by a sum vector of two, $A\cos 2\pi fct$ and [Bcos] Bsin $2\pi fct$, vectors 81 and 82 which respectively represent the two 90°-out-of-phase carriers. When the distal point of a sum vector from the zero point represents a signal point, the 16 QAM signal has 16 signal points determined by a combination of four horizontal amplitude values a_1, a_2, a_3, and a_4 and four vertical amplitude values b_1, b_2, b_3, and b_4. The first quadrant in FIG. 3 contains four signal points 83 at c_{11}, 84 at c_{12}, 85 at c_{22}, and 86 at c_{21}.

Please amend the paragraph beginning in Column 14, line 23 as follows:

When the distance between two adjacent signal points is great, it will be identified by the receiver with much ease. Hence, it is desirable to space the signal points at greater intervals. If two particular signal points are allocated near to each other, they are rarely distinguished and the error rate will be increased. Therefore, it is most preferable to have the signal points spaced at equal intervals as shown in FIG. 5, in which the 16 QAM signal is defined by $A_1 = A_2/2$.

Please amend the paragraph beginning in Column 14, line 31 as follows:

The transmitter 1 of the embodiment is arranged to divide an input digital signal into a first, a second, and a third data or bit stream. The 16 signal points or groups of signal points are divided into four groups. Then, 4 two-bit patterns of the first data stream are assigned to the four signal point groups respectively, as shown in FIG. 6. More particularly, when the two-bit pattern of the first data stream is 11, one of four signal points of the first signal point group 91 in the first quadrant is selected

depending on the content of the second data stream for transmission. Similarly, when 01, one signal point of the second signal point group 92 in the second quadrant is selected and transmitted. When 00, one signal point of the third signal point group 93 in the third quadrant is transmitted and when 10, one signal point of the fourth signal point group 94 in the fourth quadrant is transmitted. Also, 4 two-bit patterns in the second data stream of the 16 QAM signal, or e.g. 16 four-bit patterns in the second data stream of a 64-state QAM signal, are assigned to four signal points or sub signal point groups of each of the four signal point groups 91, 92, 93, and 94 respectively, as shown in FIG. 7. It should be understood that the assignment is symmetrical between any two quadrants. The assignment of the signal points to the four groups 91, 92, 93, and 94 is determined by priority to the two-bit data of the first data stream. As the result, two-bit data of the first data stream and two-bit data of the second data stream can be transmitted independently. Also, the first data stream will be demodulated by using a common 4 PSK receiver having a given antenna sensitivity. If the antenna sensitivity is higher, a modified type of the 16 QAM receiver of the present invention will intercept and demodulate both the first and second data [stream] streams with equal success.

Please amend the paragraph beginning in Column 15, line 63 as follows:

It is known that the four signal points are [allcated] allocated at equal distances for achieving optimum energy utilization. FIG. 18 illustrates an example where the four signal points 125, 126, 127, and 128 represent 4 two-bit patterns, 11, 01, 00, and 10 respectively. It is also desirable for successful data transfer from the digital transmitter 51 to the first receiver 23 that the 4 PSK signal from the digital transmitter 51 has an amplitude of not less than a given level. More specifically, when the minimum amplitude of the 4 PSK signal needed for transmission from the digital transmitter 51 to the first receiver 23 of 4 PSK mode, or the distance between 0 and a_1 in FIG. 18 is A_{TO}, the first receiver 23 must successfully intercept any 4 PSK signal having an amplitude of more than A_{TO}.

Please amend the paragraph beginning in Column 16, line 11 as follows:

The first receiver 23 is arranged to receive at its small-diameter antenna 22 a desired or 4 PSK signal which is transmitted from the transmitter 1 or digital transmitter 51 respectively through the

transponder 12 of the satellite 10 and demodulate it with the demodulator [24] 25. In more detail, the first receiver 23 is substantially designed for interception of a digital TV or data communications signal of 4 PSK or 2 PSK mode.

Please amend the paragraph beginning in Column 16, line 19 as follows:

FIG. 19 is a block diagram of the first receiver 23 in which an input signal received by the antenna 22 from the satellite [12] 10 is fed through the input unit 24 to a carrier reproducing circuit 131 where a carrier wave is demodulated and to a $\pi/2$ phase shifter 132 where a 90° phase carrier wave is demodulated. Also, two 90°-out-of-phase components of the input signal are respectively detected by a first phase detector circuit 133 and a second phase detector circuit 134 and are respectively transferred to first 136 and second discrimination/demodulation circuits 136 and 137. Two demodulated components from their respective discrimination/demodulation circuits 136 and 137, which have separately been discriminated at units of time slot by means of timing signals from a timing wave extracting circuit 135, are fed to a first data stream reproducing unit 232 where they are combined into a first data stream signal which is then delivered as an output from the output unit 26.

Please amend the paragraph beginning in Column 17, line 50 as follows:

If the transponder of a satellite supplies an abundance of energy, the forgoing technique of 16 to 64-state QAM mode transmission will be feasible. However, the transponder of the satellite in any existing satellite transmission system is strictly limited in the power supply due to its compact size and the capability of solar batteries. If the transponder or satellite is increased in size and thus weight, its launching cost will soar. This disadvantage will rarely be eliminated by traditional techniques unless the cost of launching a satellite rocket is reduced [by] to a considerable level. In the existing system, a common communications satellite provides as low as 20 W of power and a common broadcast satellite offers 100 W to 200 W at best. For transmission of such a 4 PSK signal in the symmetrical 16-state QAM mode as shown in FIG. 9, the minimum signal point distance [is needed] needed is $3A_{TO}$ as the 16 QAM amplitude is expressed by $2A_1 = A_2$. Thus, the energy needed for the purpose

is nine times greater than that for transmission of a common 4 PSK signal, in order to maintain compatibility. Also, any conventional satellite transponder can hardly provide [a] power for enabling such a small antenna of the 4 PSK first receiver to intercept a transmitted signal therefrom. For example, in the existing 40 W system, 360 W is needed for appropriate signal transmission and will be unrealistic with respect to cost.

Please amend the paragraph beginning in Column 18, line 13 as follows:

In more detail, while the 4 PSK signal can be intercepted by a common low cost receiver system having a small antenna, the 16 QAM signal is intended to be received by a high cost, high quality, multiple-bit modulating receiver system with a medium or large sized antenna which is designed for providing highly valuable services, e.g. HDTV entertainment, to a particular person who invests more money. This allows both 4 PSK and 16 QAM signals, if desired, with a 64 [DMA] <u>QAM</u>, to be transmitted simultaneously with the help of a small increase in the transmitting power.

Please amend the paragraph beginning in Column 18, line 23 as follows:

For example, the transmitting power can be maintained low when the signal points are allocated at $A_1 = A_2$ as shown in FIG. 10. The amplitude A(4) for transmission of 4 PSK data is expressed by a vector 96 equivalent to <u>the</u> square root of $(A_1+A_2)^2+(B_1+B_2)^2$. Then,

$$|A(4)|_2 = A_1^2 + B_1^2 = A^2_{TO} + A^2_{TO} = 2A^2_{TO}$$

$$|A(16)|_2 = (A_1 + A_2)^2 + (B_1 + B_2)^2 = 4A^2_{TO} + 4A^2_{TO} = 8A_{TO}$$

$$|A(16)|/|A(4)| = 2$$

Please amend the paragraph beginning in Column 18, line 31 as follows:

Accordingly, the 16 QAM signal can be transmitted at a two times greater amplitude and a four times greater transmitting energy than those needed for the 4 PSK signal. A modified 16 QAM signal according to the present invention will not be demodulated by a common receiver designed for symmetrical, equally distanced signal point QAM. However, it can be demodulated with the second receiver 33 when two threshold values A_1 and A_2 are preset to appropriate values. In FIG. 10, the

minimum distance between two signal points in the first segment of the signal point group 91 is A_1 and $A_2/2A_1$ is established as compared with the distance $2A_1$ of 4 PSK. Then, as $A_1 = A_2$, the distance becomes 1/2. This explains that the signal receiving sensitivity has to be two times greater for the same error rate and four times greater for the same signal level. For having a four times greater value of sensitivity, the radius r_2 of the antenna 32 of the second receiver 33 has to be two times greater than the radius r_1 of the antenna 22 of the first receiver 23 thus satisfying $r_2 = 2r_1$. For example, the antenna 32 of the second receiver 33 is 60 cm diameter when the antenna 22 if the first receiver 23 is 30 cm. In this manner, the second data stream representing the high frequency component of an HDTV will be carried on a signal channel and demodulated successfully. As the second receiver 33 intercepts the second data stream or a higher data signal, its owner can enjoy a [of] high <u>return of</u> investment [return]. Hence, the second receiver 33 of a high price may be accepted. As the minimum energy for transmission of 4 PSK data is predetermined, the ratio n_{16} of modified 16 APSK transmitting energy to 4 PSK transmitting energy will be calculated according to the antenna radius r_2 of the second receiver 33 using a ratio between A_1 and A_2 shown in FIG. 10.

Please amend the paragraph beginning in Column 18, line 63 as follows:

In particular, n_{16} is expressed by $((A_1+A_2)/A_1)^2$ which is the minimum energy for transmission of 4 PSK data. As the signal point distance suited for modified 16 QAM interception is A_2, [The] <u>the</u> signal point distance for 4 PSK interception is $2A_1$, and the signal point distance ratio is $A_2/2A_1$, the antenna radius r_2 is determined as shown in FIG. 11, in which the curve 101 represents the relationship between the transmitting energy ratio n_{16} and the radius r_2 of the antenna 22 of the second receiver 23.

Please amend the paragraph beginning in Column 19, line 27 as follows:

If the distance between any two signal point group segments shown in FIG. 10 is 2A(4) and the maximum amplitude is 2A(16), A(4) and A(16)-A(4) are proportional to [A1] <u>A_1</u> and [A2] <u>A_2</u> respectively. Hence, $(A(16))^2<5(A(14))^2$ is established.

Please amend the paragraph beginning in Column 19, line 45 as follows:

This relationship between [r^3] r_3 and n of a 64 QAM signal is also shown in the graphic representation of FIG. 13.

Please amend the paragraph beginning in Column 19, line 47 as follows:

It is understood that the signal point assignment shown in FIG. 12 allows the second receiver 33 to demodulate only two-bit patterns of 4 PSK data. Hence, it is desirable [for] to have compatibility [between] among the first, second, and third receivers that the second receiver 33 is capable of demodulating a modified 16 QAM form from the 64 QAM modulated signal.

Please amend the paragraph beginning in Column 19, line 53 as follows:

The compatibility [between] among the three discrete receivers can be implemented by a three-level grouping of signal points, as illustrated in FIG. 14. A description follows referring to the first quadrant in which the first signal point group segment 91 represents the two-bit pattern 11 of the first data stream.

Please amend the paragraph beginning in Column 20, line 17 as follows:

The signal point allocation for providing compatibility [between] among the three levels will be described.

Please amend the paragraph beginning in Column 20, line 26 as follows:

FIG. 15 shows that they are spaced by $2/3A_2$. In this case, the distance between the two signal points 201 and 202 in the first sub segment 181 is $A_2/6$. The transmitting energy needed for signal interception with the third receiver 43 is now calculated. If the radius of the antenna [32] 42 is r_3 and the needed transmitting energy is n_{64} times the 4 PSK transmitting energy, the equation is expressed as:

[$R_3^2(12r_1)^2/(n-1)$] $R_3^2=(12r_1)^2/(n-1)$

Please amend the paragraph beginning in Column 20, line 34 as follows:

This relationship is also denoted by the curve 211 in FIG. 16. For example, if the transmitting energy is 6 or 9 times greater than that for 4 PSK transmission at the point 223 or 222, the antenna 32 having a radius of 8x or 6x value respectively can intercept the first, second, and third data streams for demodulation. As the signal point distance of the second data stream is close to $2/3A_2$, the relationship between r_1 and r_2 is expressed by:

$$[R_22=(3r_1)^2/(n-1)]\ \underline{R_2^2=(3r_1)^2/(n-1)}$$

Therefore, the antenna 32 of the second receiver 33 has to be slightly increased in radius as denoted by the curve 223.

Please amend the paragraph beginning in Column 21, line 6 as follows:

The block diagram of the second receiver 33 in FIG. 21 is similar in basic construction to that of the first receiver 23 shown in FIG. 19. The difference is that the radius r_2 of the antenna 32 is greater than r_1 of the antenna 22. This allows the second receiver 33 to identify a signal component involving a smaller signal point distance. The demodulator 35 of the second receiver 33 also contains first and second data stream reproducing units 232 and 233 in addition to the demodulation controller 231. There is provided a first discrimination/demodulation circuit 136 for AM demodulation of modified 16 QAM signals. As understood, each carrier is a four-bit signal having two, positive and negative, threshold values about the zero level. [AS] $\underline{\text{As}}$ apparent from the vector diagram, of FIG. 22, the threshold values are varied depending on the transmitting energy of a transmitter since the transmitting signal of the embodiment is a modified 16 QAM signal. When the reference threshold is TH_{16}, it is determined by, as shown in FIG. 22:

$$TH_{16}=(A_1+A_2/2)/(A_1+A_2)$$

Please amend the paragraph beginning in Column 22, line 50 as follows:

In case of the angular shift C-CDM, if signal points are disposed on the lines of π/n, the carrier wave reproduction circuit can reproduce the carrier wave by the use of an n-multiplier circuit in the same manner as in other embodiments. If the signal points are not disposed on the lines of π/n, the carrier wave can be reproduced by transmitting several pieces of carrier information within a predetermined period in the same manner as in other [embodiment] <u>embodiments</u>. Assuming that an angle between two signal points of the QPSK or 8-SP-APSK is $2\theta_0$ in the polar coordinate system and a first angular shift factor is P1, two signal points (r_0, $\theta_0+P_1\theta_0$) and (r_0, [%] $\underline{\theta_0}-P_1\theta_0$) are obtained by shifting the QPSK signal point in the angular θ direction by an amount $\pm P_1\theta_0$. Thus, the number of signal points are doubled. Thus, the 1-bit subchannel 3 can be added and is referred to as 8-SP-PSK of P=P1. If eight signal points are further added by shifting the 8-SP-PSK signals in the radius r direction by an amount S_1r_0, it will become possible to obtain 16-SP-APSK (P, S_1 type) as shown in FIG. 142. The subchannels 1 and 2 can be reproduced by two 8PS-PSKs having the same phase. Returning to FIG. 25(b), as the C-CDM based on the angular shift in the polar coordinate system can be applied to the PSK as shown in FIG. 141, this will be adopted to the first generation satellite broadcast service. However, if adopted to the second generation satellite broadcasting based on the APSK, this polar coordinate system C-CDM is inferior in that signal points in the same group cannot be uniformly spaced as shown in FIG. 142. Accordingly, utilization efficiency of electrical power is worsened. On the other hand, the rectangular coordinate system C-CDM has good compatibility to the PSK.

Please amend the paragraph beginning in Column 23, line 53 as follows:

As shown in FIG. 22 [and] the signal points 85, 83, are aligned on a line at an angle of $\cos(\omega t+n\pi/2)$ while 84 and 86 are off the line. Hence, the feedback of a second data stream transmitting carrier wave data from the second data stream reproducing unit 233 to a carrier reproducing circuit 131 is carried out so that no carrier needs to be extracted at the timing of the signal points 84 and 86.

Please amend the paragraph beginning in Column 23, line 60 as follows:

The transmitter 1 is arranged to transmit carrier timing signals at intervals of a given time with the first data stream for the purpose of compensation for no demodulation of the second data stream. The carrier timing signal enables one to identify the signal points 83 and 85 of the first data stream regardless of demodulation of the second data stream. Hence, the reproduction of carrier wave can be triggered by the transmitting <u>of</u> carrier data to the carrier reproducing circuit 131.

Please amend the paragraph beginning in Column 26, line 17 as follows:

The signal point data in the phase sync time slot has a particular phase and can thus be reproduced by the 4 PSK receiver. Accordingly, I_T in the phase sync signal assignment region 499 can be retrieved without error thus ensuring the reproduction of carrier waves [at] <u>with</u> accuracy.

Please amend the paragraph beginning in Column 26, line 40 as follows:

The carrier wave reproduction of the first receiver 23 shown in FIG. 19 will be explained in more detail referring to FIGS. 43 and 44. As shown <u>in</u> FIG. 43, an input signal is fed through the input unit 24 to a sync detector circuit 541 where it is sync detected. A demodulated signal from the sync detector 541 is transferred to an output circuit 542 for reproduction of the first data stream. A data of the phase sync signal assignment data region 499 (shown in FIG. 41) is retrieved by an extracting timing controller circuit 543 so that the timing of sync signals of $(2n-1)\pi/4$ data can be acknowledged and transferred as a phase sync control pulse 561 shown in FIG. 44 to a carrier reproduction controlling circuit 544. Also, the demodulated signal of the sync detector circuit 541 is fed to a frequency multiplier circuit 545 where it is 4x multiplied prior to being transmitted to the carrier reproduction controlling circuit 544. The resultant signal denoted by 562 in FIG. 44 contains true phase data 563 and other data. As illustrated by 564 in the time chart 564 of FIG. 44, the phase sync time slots 452 carrying the $(2n-1)\pi/4$ data are also contained at equal intervals. In the carrier reproducing controlling circuit 544, the signal 562 is sampled by the phase sync control pulse 561 to produce a phase sample signal 565 which is then converted through a sample and hold operation into a phase signal 566. The phase signal 566 of the carrier reproduction controlling circuit 544 is fed

through a loop filter 546 to a VCO 547 where its relevant carrier wave is reproduced. The reproduced carrier is then sent to the sync detector circuit 541.

Please amend the paragraph beginning in Column 27, line 44 as follows:

The reproduction of a carrier wave by 16x frequency multiplication will be explained. The transmitter 1 shown in FIG. 1 is arranged to modulate and transmit a modified 16 QAM signal with assignment of its signal points at $n\pi/8$ phase as shown in FIG. 46. At the first receiver 23 shown in FIG. 19, the carrier wave can be reproduced with its COSTAS carrier reproduction controller circuit containing a 16x multiplier circuit 661 shown in FIG. 48. The signal points at each $n\pi/8$ phase shown in FIG. 46 are processed at the first quadrant b the action of the 16x multiplier circuit 661, whereby the carrier will be reproduced by the combination of a loop filter 546 and a VCO [541] <u>547</u>. Also, the absolute phase may be determined from 16 different phases by assigning a unique word to the sync region.

Please amend the paragraph beginning in Column 28, line 63 as follows:

When the present invention is applied to a TV signal transmission service, three different quality pictures are carried on one signal channel wave and will offer compatibility with each other. Although the first embodiment refers to a 4 PSK, a modified 8 QAM, a modified 16 QAM, and a modified 64 QAM signal, other signals will also be employed with equal success including a 32 QAM, a 256 QAM, an 8 PSK, [and] a 16 PSK, <u>and</u> a 32 PSK signal. It would be understood that the present invention is not limited to a satellite transmission system and can be applied to a terrestrial communications system or a cable transmission system.

Please amend the paragraph beginning in Column 29, line 11 as follows:

A second embodiment of the present invention is featured in which the physical multi-level arrangement of the first embodiment is divided into small levels through e.g. discrimination in error correction capability, thus forming a logic multi-level construction. In the first embodiment, each multi-level channel has different levels in the [electrical] <u>electric</u> signal amplitude or physical

demodulating capability. The second embodiment offers different levels in the logic reproduction capability such as error correction. For example, the data D_1 in a multi-level channel is divided into two, D_{1-1} and D_{1-2}, components and D_{1-1} is more increased in the error correction capability than D_{1-2} for discrimination. Accordingly, as the error detection and correction capability is different between D_{1-1} and D_{1-2} at demodulation, D_{1-1} can successfully be reproduced within a given error rate when the C/N level of an original transmitting signal is as low as disenabling the reproduction of D_{1-2}. This will be implemented using the logic multi-level arrangement.

Please amend the paragraph beginning in Column 29, line 38 as follows:

This will be explained in more detail referring to FIG. [87] <u>85</u> in which D_{1-1} is reproduced from a lowest C/N signal. If the C/N rate is d at minimum, three components D_{1-2}, D_{2-1} and D_{2-2} cannot be reproduced while D_{1-1} is reproduced. If C/N is not less than c, D_{1-2} can also be reproduced. Equally, when C/N is b, D_{2-1} is reproduced and when C/N is a, D_{2-2} is reproduced. As the C/N rate increases, the reproducible signal levels are increased in number. The lower the C/N, the fewer the reproducible signal levels. This will be explained in the form of relationship between transmitting distance and reproducible C/N value referring to FIG. 86. In common, the C/N value of a received signal is decreased in proportion to the distance of transmission as expressed by the real line 861 in FIG. 86. It is now assumed that the distance from a transmitter antenna to a receiver antenna is La when C/N=a, Lb when C/N=b, Lc when C/N=c, Ld when C/N=d, and Le when C/N=e. If the distance from the transmitter antenna is greater than Ld, D_{1-1} can be reproduced as shown in FIG. 85 where the receivable area 862 is denoted by the hatching. In other words, D_{1-1} can be reproduced within a most extended area. Similarly, D_{1-2} can be reproduced in an area 863 when the distance is not more than Lc. In this area 863 containing the area 862, D_{1-1} can with no doubt be reproduced. In a small area [854] <u>864</u>, D_{2-1} can be reproduced and in a smallest area 865, D_{2-2} can be reproduced. As understood, the different data levels of a channel can be reproduced corresponding to degrees of declination in the C/N rate. The logic multi-level arrangement of the signal transmission system of the present invention can provide the same effect as of a traditional analogue transmission system in

which the amount of receivable data is gradually lowered as the C/N rate decreases.

Please amend the paragraph beginning in Column 30, line 20 as follows:

The main ECC encoder 872a has a higher error correction capability than that of the sub ECC encoder 873a. Hence, D_{1-1} can be reproduced at a lower rate of C/N than D_{1-2} as apparent from the CN-level diagram of FIG. 85. More particularly, the logic level of D_{1-1} is less affected by declination of the C/N than that of D_{1-2}. After error correction code encoding, D_{1-1} and [D_{2-2}] $\underline{D}_{1-2}$ are summed by a summer 874a to a D_1 signal which is then transferred to the modulator 4. The other two signals D_{2-1} and D_{2-2} of the divider circuit 3 are error correction encoded by two, main and sub, ECC encoders [872 b] 872b and 873b of a second ECC encoder 871b respectively and then, summed by a summer 874b to a D_2 signal which is transmitted to the modulator 4. The main ECC encoder 872b is higher in the error correction capability than the sub ECC encoder 873b. The modulator 4 in turn produces from the two, D_1 and D_2, input signals a multi-level modulated signal which is further transmitted from the transmitter unit 5. As understood, the output signal from the transmitter 1 has two physical levels D_1 and D_2 and also, four logic levels D_{1-1}, D_{1-2}, D_{2-1}, and D_{2-2} based on the two physical levels for providing different error correction capabilities.

Please amend the paragraph beginning in Column 30, line 42 as follows:

The reception of such a multi-level signal will be [expelained] explained. FIG. 88 is a block diagram of a second receiver 33 which is almost identical in construction to that shown in FIG. 21 and described in the first embodiment. The second receiver 33 arranged for intercepting multi-level signals from the transmitter 1 shown in FIG. 87 further comprises first and second ECC decoder 876a 876b, in which the demodulation of QAM, or any of ASK, PSK, and FSK if desired, is executed.

Please amend the paragraph beginning in Column 30, line 51 as follows:

As shown in FIG. 88, a receiver signal is demodulated by the demodulator 35 to the two, D_1 and D_2, signals which are then fed to two dividers 3a and 3b respectively where they are divided into four logic levels D_{1-1}, D_{1-2}, D_{2-1}, and D_{2-2}. The four signals are transferred to the first and second ECC

decoders 876a and 876b in which D_{1-1} is error corrected by a main ECC decoder 877a, D_{1-2} by a sub ECC decoder 878a, D_{2-1} by a main ECC decoder 877b, D_{2-2} by a sub ECC decoder 878b before all being sent to the summer 37. In the mixer 37, the four, D_{1-1}, D_{1-2}, D_{2-1}, and D_{2-2}, error corrected signals are combined into a signal which is then delivered from the output unit 36.

Please amend the paragraph beginning in Column 31, line 1 as follows:

The action of discriminating the error correction capability between the main ECC decoders 877a and 877b of high code gain and the sub ECC decoders 878a and 878b of low code gain will now be described in more detail. It is a good idea for having a difference in the error correction capability, i.e., in the code gain, to use in the sub ECC decoder a common coding technique, e.g. Reed-Solomon or BCH method, as shown in FIG. 165(b) for the ECC decoder, having a standard code distance and in [%he] the main ECC decoder, another encoding technique in which distance between correction codes is increased using Reed-Solomon codes, their product codes, or other long-length codes or a trellis decoder 744p, 744q, and 744r shown in FIGS. 128(d), 128(e), 128(f). A variety of known techniques for increasing the error correction code distance have been introduced and will not be explained in detail. The present invention can be associated with any known technique for having the logic multi-level arrangement.

Please amend the paragraph beginning in Column 31, line 28 as follows:

The logic multi-level arrangement will be explained in [conjuction] conjunction with a diagram of FIG. 89 showing the relationship between C/N and error [race] rate after error correction. As shown, the straight line 881 represents D_{1-1} at the C/N and error rate relation and the line 882 represents D_{1-2} at same.

Please amend the paragraph beginning in Column 32, line 3 as follows:

[Thanking] Thanks to up-to-date compression techniques, compressed image data can be transmitted in the logic multi-level arrangement for enabling a receiver station to reproduce a higher quality image than that of an analogue system and also, with not sharply but at steps declining the

signal level for ensuring signal interception in a wider area. The present invention can provide an extra effect of the multi-layer arrangement which is hardly implemented by a known digital signal transmission system without deteriorating high quality image data.

Please amend the paragraph beginning in Column 32, line 55 as follows:

FIG. 29 is a schematic total view illustrating the third embodiment in the form of a digital TV broadcasting system. An input video signal 402 of super high resolution TV image is fed to an input unit 403 of a first video encoder 401. Then, the signal is divided by a divider circuit 404 into three, first, second, and third, data streams which are transmitted to a compressing circuit 405 for data compression before being further delivered.

Please amend the paragraph beginning in Column 33, line 9 as follows:

A part or all of the four second data streams from their respective encoders 401, 409, 410, and 411 are transferred to a second multiplexer 414 of the multiplexer 412 where they are time multiplexed to a second data stream multiplex signal which is then fed to transmitter 1. Also, a part or all of the four third data streams are transferred to a third multiplexer 415 where they are time multiplexed to a data stream multiplex signal which is then fed to the transmitter 1.

Please amend the paragraph beginning in Column 34, line 24 as follows:

The first video decoder 421 will now be explained in more detail referring to FIG. 31. The first data stream or D_1 signal of the first receiver 23 is fed through an input unit 501 to a descrambler 502 of the first video decoder 421 where it is descrambled. The descrambled D_1 signal is expanded by an expander 503 to $H_L V_L$ which is then fed to an aspect ratio changing circuit 504. Thus, the H_L V_L signal can be delivered through an output unit 505 as a standard 500, letterbox format 507, wide-screen 508, or sidepanel format NTSC signal 509. The scanning format may be of non-interlace or interlace type and its NTSC mode lines may be 525 or doubled to 1050 by double tracing. When the received signal from the digital transmitter 51 is a digital TV signal of 4 PSK mode, it can also be converted by the first receiver 23 and the first video decoder 421 to a TV picture. The second video

decoder 422 will be explained in more detail referring to the block diagram of FIG. 32. The D_1 signal of the second receiver 33 is fed through a first input 521 to a first expander 522 for data expansion and then, transferred to an oversampler 523 where it is sampled at 2x. The oversampled signal is filtered by a vertical lowpass filter 524 into H_LV_L. Also, the D_2 signal of the second receiver 33 is fed through a second input 530 to a divider 531 where it is divided into three components which are then transferred to second, third, and fourth expanders 532-534 respectively for data expansion. The three expanded components are sampled at 2x by three oversamplers 535, 536, and 537 and filtered by a vertical highpass 538, a vertical lowpass 539, and a vertical highpass filter 540 respectively. Then, H_LV_L from the vertical lowpass filter 524 and H_LV_H from the vertical highpass filter 538 are summed by an adder 525, sampled by an oversampler 541, and filtered by a horizontal lowpass filter 542 into a low frequency horizontal video signal. H_HV_L from the vertical lowpass filter 539 and H_HV_H 1 from the vertical highpass filter 540 are summed by an adder 526, sampled by an oversampler 544, and filtered by a horizontal highpass filter 545 to a high frequency horizontal video signal. The two, high and low frequency, horizontal video signals are then summed by an adder 543 into a high resolution video signal HD which is further transmitted through an output unit 546 as a video output 547 of e.g. HDTV format. If desired a traditional NTSC video output can be reconstructed with equal success.

Please amend the paragraph beginning in Column 35, line 1 as follows:

FIG. 33 is a block diagram of the third video decoder 423 in which the D_1 and D_2 signals are fed through a first 521 and a second input 530 respectively to a high frequency band video decoder circuit 527 where they are converted to an HD signal in the same manner as described above. The D_3 signal is fed through a third input 551 to a super high frequency band video decoder circuit 552 where it is expanded, descrambled, and composed into H_HV_H 2 signal. The HD signal of the high frequency band video decoder circuit 527 and the H_HV_H 2 signal of the super high frequency band video decoder circuit 552 are summed by a summer 553 to a super high resolution TV or S-HD signal which is then delivered through an output unit 554 as a super resolution video output 555.

Please amend the paragraph beginning in Column 35, line 15 as follows:

The action of multiplexing in the multiplexer 412 shown in FIG. 29 will be explained in more detail. FIG. 34 illustrates a data assignment in which the three, first, second, and third, data streams D_1, D_2, D_3 contain in a period of T six NTSC channel data L1, L2, L3, L4, L5, L6, six HDTV channel data M1, M2, M3, M4, M5, M6 and six S-HDTV channel data H1, H2, H3, H4, H5, H6 respectively. In operation, the NTSC or D_1 signal data L1 to L6 are time multiplexed by TDM process during the period T. More particularly, H_LV_L of D_1 is assigned to a domain 601 for the first channel. Then, a difference data M1 between HDTV and NTSC or a sum of H_LV_H, H_HV_L, and H_HV_H 1 is assigned to a domain 602 for the first channel. Also, a difference data [HI] H1 between HDTV and super HDTV or H_HV_H 2 (See FIG. 30) is assigned to a domain 603 for the first channel.

Please amend the paragraph beginning in Column 35, line 48 as follows:

FIG. 35 shows another data assignment L1 of a first channel NTSC signal is assigned to a [fist] first domain 601. The domain 601 which is allocated at the front end of the first data stream D_1, also contains at front a data S_{11} including a descrambling data and the demodulation data described in the first embodiment. A first channel HDTV signal is transmitted as L1 and M1. M1, which is thus a difference data between NTSC and HDTV, is assigned to two domains 602 and 611 of D_2. If L1 is a compressed NTSC component of 6 Mbps, M1 is two times higher, that is, 12 Mbps. Hence, the total of L1 and M1 can be demodulated at 18 Mbps with the second receiver 33 and the second video decoder 423. According to current data compression techniques, HDTV compressed signals can be reproduced at about 15 Mbps. This allows the data assignment shown in FIG. 35 to enable simultaneous reproduction of an NTSC and HDTV first channel signal. However, this assignment allows no second channel HDTV signal to be carried. S21 is a descrambling data in the HDTV signal. A first channel super HDTV signal component comprises L1, M1, and H1. The difference data H1 is assigned to three domains 603, 612, and 613 of D_3. If the NTSC signal is 6 Mbps, the super HDTV is as high as 36 Mbps. When a compressed rate is increased, super HDTV video data of about 2000 scanning line for reproduction of a cinema size picture for commercial use can be transmitted in an

equal manner.

Please amend the paragraph beginning in Column 36, line 35 as follows:

FIG. 50 illustrates a TDMA method in which each data burst 721 is accompanied at front a sync data 731 and a card data 741. Also, a frame sync data 720 is provided at the front of a frame. Like channels are assigned to like time slots. For example, a first time slot 750 carries NTSC, HDTV, and super HDTV data of the first channel simultaneously. The six time slots 750, 750a, 750b, 750c, 750d, 750e, <u>are</u> arranged independent from each other. Hence, each station can offer NTSC, HDTV, and/or super HDTV services independently of the other stations through selecting a particular channel of the time slots. Also, the first receiver 23 can reproduce an NTSC signal when equipped with a horizontal polarization antenna and both NTSC and HDTV signals when equipped with a compatible polarization antenna. In this respect, the second receiver 33 can reproduce a super HDTV at lower resolution while the third receiver 43 can reproduce a full super HDTV signal. According to the third embodiment, a compatible signal transmission system will be constructed. It is understood that the data assignment is not limited to the burst mode TDMA method shown in FIG. 50 and another method such as time division multiplexing of continuous signals as shown in FIG. 49 will be employed with equal success. Also, a data assignment shown in FIG. 51 will permit a HDTV signal to be reproduced at high resolution.

Please amend the paragraph beginning in Column 37, line 1 as follows:

First, the error rate in 16 SRQAM will be calculated. FIG. 99 shows a vector diagram of 16 SRQAM signal points. As apparent from the first quadrant, the 16 signal points of standard 16 QAM including 83a, [83b] <u>85</u>, 84a, [83a] <u>86a</u> are allocated at equal intervals of 2δ.

Please amend the paragraph beginning in Column 38, line 14 as follows:

The curve 902a represents a D_2 level SRQAM signal at n=1.5 which can be reproduced at the error rate of $10^{-1.5}$ only when its C/N rate is 2.5 dB higher than that of the conventional 32 QAM of the curve 900. Also, the curves 901b and 902b represent D_1 and D_2 SRQAM signals at n=2.0

respectively. The [curves] <u>curve</u> 902c represents a D_2 SRQAM signal at n=2.5. It is apparent that the C/N rate of the SRQAM signal at the error data of $10^{-1.5}$ is 5 dB, 8 dB, and 10 dB higher at n=1.5, 2.0, and 2.5 respectively in the D_1 level and 2.5 dB lower in the D_2 level than that of a common 32 QAM signal.

Please amend the paragraph beginning in Column 39, line 10 as follows:

In case of the 32 SRQAM signal of the present invention or the 8-VSB shown in FIG. 68, <u>a</u> three-level signal transmission system is constituted as shown in FIGS. 133 and 137. This permits a low resolution NTSC signal of MPEG level to be carried on the 1-1 data stream D_{1-1}, a medium resolution TV data of e.g. NTSC system to be carried on the 1-2 data stream D_{1-2}, and a high frequency component of HDTV data to be carried on the second data stream D_2. Accordingly, the service area of the 1-2 data stream of the SRQAM signal is increased to a 70 mile point 910a while <u>that</u> of the second data stream remains within a 55 mile point 910b, as shown in FIG. 105. FIG. 106 illustrates a computer simulation result of the service area of the 32 SRQAM signal of the present invention, which is similar to FIG. 53 but explains it in more detail. As shown, the regions 708, 703c, 703a, 703b, and 712 represent a conventional 32 QAM receivable area, a 1-1 data level D_{1-1} receivable area, a 1-2 data level D_{1-2} receivable area, a second data level D_2 receivable area, and a service area of a neighbor analogue TV station respectively. The conventional 32 QAM signal data used in this drawing is based on a conventionally disclosed one.

Please amend the paragraph beginning in Column 39, line 32 as follows:

For common 32 QAM signal, the 60-mile-radius service area can be established theoretically. The signal level will however be attenuated by geographical or weather conditions and particularly, considerably declined [at] near the limit of the service area.

Please amend the paragraph beginning in Column 41, line 38 as follows:

Although above embodiment combines the C-CDM and the TDM, it is also possible to combine the C-CDM with the FDM (Frequency Division Multiplex) to obtain similar modulation

effect of threshold values. Such a system can be used for a TV broadcasting, and FIGS. 108(a)-108(e) show [shows] a frequency distribution of a TV signal. A spectrum 725 represents a frequency distribution of a conventional analogue, e.g. NTSC, broadcasting signal. The largest signal is a video carrier 722. A color carrier 723 and a sound carrier 724 are not so large. There is known a method of using an FDM for dividing a digital broadcasting signal into two frequencies. In this case, a carrier is divided into a first carrier 726 and a second carrier 727 to transmit a first 720 and a second signal 721 respectively. Interference can be lowered by placing first and second carriers 726 and 727 sufficiently far from the video carrier 722. The first signal 720 serves to transmit a low resolution TV signal at a large output level, while the second signal 721 serves to transmit a high resolution TV signal at a small output level. Consequently, the multi-level signal transmission making use of an FDM can be realized without being bothered by obstruction.

Please amend the paragraph beginning in Column 41, line 59 as follows:

FIG. 134 shows an example of a conventional method using a 32 QAM system. As the subchannel A has a larger output than the subchannel B, a threshold value for the subchannel A, i.e. a threshold 1, can be set small 4~5 dB than a threshold value for the subchannel B, i.e. a threshold 2. Accordingly, a two-level broadcasting having 4~5 dB threshold difference can be realized. In this case, however, a large reduction of signal reception amount will occur if the receiving signal level decreases below the threshold 2. Because the second signal 721a, having a large information amount as shaded in the drawing, cannot be received in such a case and only the first signal 720a, having a small information amount, is received. Consequently, a [pecture] <u>picture</u> quality brought by the second level will be extremely worse.

Please amend the paragraph beginning in Column 42, line 23 as follows:

By transmitting a normal resolution component in one subchannel, it becomes possible to increase the number of multiple level and expand a low resolution service area. This low-threshold subchannel is utilized for transmitting important information such as sound information, sync information, headers of respective data, because these information carried on this low-threshold

subchannel can be surely received. Thus stable reception is feasible. If a subchannel is newly added in the second signal 721 in the same manner, the number of levels of multi-level transmission can be increased in the service area. In the case where an HDTV signal has 1050 scanning lines, [an] a new service area equivalent to 775 lines can be provided in addition to 525 lines.

Please amend the paragraph beginning in Column 43, line 17 as follows:

For example, the error rate of the subchannel 1 of 8PS-APSK, explained in the embodiment 1 with reference to FIG. 139, will be expressed as follows:

$$[\, Pe_{1-8} = \frac{1}{4} erfc\left(\frac{\delta}{\sqrt{2\alpha}}\right) + \frac{1}{4} erfc\left(\frac{(S_1+1)\delta}{\sqrt{2\sigma}}\right) \,]$$

$$Pe_{1-8} = \frac{1}{4} erfc\left(\frac{\delta}{\sqrt{2\sigma}}\right) + \frac{1}{4} erfc\left(\frac{(S_1+1)\delta}{\sqrt{2\sigma}}\right)$$

Please amend the paragraph beginning in Column 43, line 23 as follows:

Furthermore, the error rate of the subchannel 1 of 16-PS-APSK (PS type), explained with reference to FIG. 142, will be expressed as [follow] follows:

$$Pe_{1-16} = \frac{1}{8} erfc\left(\frac{\delta}{\sqrt{2\sigma}}\right) + \frac{1}{8} erfc\left(\frac{(S_2+1)\delta}{\sqrt{2\sigma}}\right) +$$

$$\frac{1}{8} erfc\left(\frac{(S_1+1)\delta}{\sqrt{2\sigma}}\right) + \frac{1}{8} erfc\left(\frac{(S_1+S_2+1)\delta}{\sqrt{2\sigma}}\right)$$

Please amend the paragraph beginning in Column 43, line 36 as follows:

FIG. 37 illustrates the entire arrangement of a signal transmission system of the fourth embodiment, which is arranged for terrestrial service and similar in both construction and action to

that of the third embodiment shown in FIG. 29. The difference is that the transmitter antenna 6 is replaced by a terrestrial antenna 6a and the receiver antennas 22, [23, and 24] 32, and 42 are also replaced by three terrestrial antennas 22a, [23a, and 24a] 32a, and 42a. The action of the system is identical to that of the third embodiment and will not be explained in more detail. The terrestrial broadcast service unlike a satellite service depends much on the distance between the transmitter antenna 6a to the receiver antennas 22a, 32a, and 42a. If a receiver is located far from the transmitter, the level of a received signal is low. Particularly, a common multi-level QAM signal can hardly be demodulated by the receiver which thus reproduces no TV program.

Please amend the paragraph beginning in Column 45, line 10 as follows:

In the service area of the digital TV station 701, there are three interference regions developed by signal interference from the analogue TV station 711. Both HDTV and NTSC signals can hardly be intercepted in the first region 705. Although fairly interfered, an NTSC signal may be intercepted at an equal level in the second region 706 denoted by the left down hatching. The NTSC signal is carried on the first data stream which can be reproduced at a relatively low C/N rate and will thus be [minimum] minimally affected when the C/N rate is declined by signal interference from the analogue TV station 711.

Please amend the paragraph beginning in Column 45, line 42 as follows:

Although the embodiment employs a two-level signal transmission method, a three-level method such as shown in FIG. 78 will be used with equal success. If an HDTV signal is divided into three picture levels-HDTV, NTC, and low resolution NTSC, the service area shown in FIG. 53 will be increased from two levels to three levels where the signal propagation is extended radially and outwardly. Also, low resolution NTSC signals can be received at an acceptable level at the first signal interference region 705 where NTSC signals are hardly [be] intercepted in the two-level system. As understood, the signal interference is also involved from a digital TV station to an analogue TV station.

Please amend the paragraph beginning in Column 46, line 1 as follows:

FIG. 55 shows a similar result according to the system of the present invention. As apparent, the HDTV signal receivable area 703 is a little bit smaller than the equal area 708 of the conventional system. However, the lower resolution or NTSC TV signal receivable area 704 will be increased as compared with the conventional system. The hatching area represents a region where the NTSC level signal of a program can be received while HDTV signal of the [seme] same is hardly intercepted. At the first interference region 705, both HDTV and NTSC signals cannot be intercepted due to signal interference from an analogue station 711.

Please amend the paragraph beginning in Column 46, line 32 as follows:

FIG. 56 illustrates signal interference between two digital TV stations in which a neighboring TV station 701a also provides a digital TV broadcast service, as compared with an analogue station in FIG. 52. Since the level of a transmitting signal becomes high, the HDTV service or high resolution TV signal receivable area 703 [in] is increased to an extension equal to the service area 702 of an analogue TV system.

Please amend the paragraph beginning in Column 47, line 31 as follows:

The two signal point [group] groups are assigned one-bit patterns of the first data stream D_1, as shown in FIG. 59(a). More particularly, a bit 0 of binary system is assigned to the first signal point group 725 and another bit 1 to the second signal point group 726. Then, a one-bit pattern of the second data stream D_2 is assigned to each signal point. For example, the two signal points 721 and 723 are assigned $D_2=0$ and the other two signal points 722 and 724 are assigned $D_2=1$.

Please amend the paragraph beginning in Column 47, line 39 as follows:

The multi-level signal transmission of the present invention can be implemented in an ASK mode using the foregoing signal point assignment. The system of the present invention works in the same manner as of a conventional equal signal point distance technique when the signal to noise ratio or C/N rate is high. If the C/N rate becomes low and no data can be reproduced by the conventional

technique, the present system ensures reproduction of the first data stream D_1 but not the second data stream D_2. In more detail, the state at a low C/N is shown in FIG. 60 illustrating the constellation of ASK of 4 VSB. The signal points transmitted are displaced by a Gaussian [distrigution] distribution to ranges 721a, 722a, 723a, and 724a respectively at the receiver side due to noise and transmission distortion. Therefore, the distinction between the two signals 721 and 722 in the case of slice level 2 or between 723 and 724 in the case of slice level 4 will hardly be executed. In other words, the error rate in the second data stream D_2 will be increased. As apparent from FIG. 60, the two signal points 721 and 722 are easily distinguished from the other two signal points 723 and 724. The distinction between the two signal point groups 725 and 726 can thus be carried out with ease. As the result, the first data stream D_1 will be reproduced at a low error rate.

Please amend the paragraph beginning in Column 48, line 6 as follows:

FIG. 61 is a block diagram of a transmitter 741 in which an input unit 742 comprises a first data stream input 743 and a second data stream input 744. A carrier wave from a carrier generator 64 is amplitude modulated by a multiplier 746 using an input signal fed through a processor 745 from the input unit [743] 742 to provide the 4-level or 8-level ASK signal, as shown in FIG. 62(a). The modulated signal, i.e., the 4-level or 8-level ASK signal is then band limited by a band pass filter 747 into a vestigial side band having some residual side band of the carrier, as shown in FIG. 62(b), i.e., to an ASK signal of e.g. VSB mode which is then delivered from an output unit 748.

Please amend the paragraph beginning in Column 49, line 1 as follows:

FIG. 65 is a block diagram of a TV receiver for such a digital TV broadcast system. A 4-VSB or 8-VSB digital TV signal intercepted by a terrestrial antenna 32a is fed to an input 752 of a receiver 781. The signal is then transferred to a VSB detection/demodulation circuit 760 where a desired channel signal is selected and demodulated to two, first and second, data streams D_1 and D_2 which are then fed to first and second data stream outputs 758 and 759 respectively. The operation in the receiver unit 751 is similar to that described previously and will not be explained in more detail. The two data streams D_1 and D_2 are sent to a divider unit 776 in which D_1 is divided by a divider 777 into

two components; one or compressed H_LV_L is transferred to a first input 521 of a second video decoder 422 and the other is fed to a summer 778 where it is summed with D_2 prior to transfer to a second input 531 of the second video decoder 422. Compressed H_LV_L is then sent from the first input 521 to a first expander 523 where it is expanded to H_LV_L of the original length which is then transferred to a video mixer 548 and an aspect ratio changing circuit 779. When the input TV signal is an HDTV signal, H_LV_L represents a wide-screen NTSC signal. When the same is an NTSC signal, H_LV_L represents a lower resolution video signal, e.g. MPEG1, [that] <u>than</u> an NTSC level.

Please amend the paragraph beginning in Column 50, line 18 as follows:

The TV receiver 781 may have a further arrangement shown in FIG. 67, which serves as both a satellite broadcast receiver for demodulation of PSK signals and a terrestrial broadcast receiver for demodulation of VSB signals. In operation, a PSK signal received by a satellite antenna 32 is mixed by a mixer 786 with a signal from an oscillator 787 into a low frequency signal which is then fed through an input unit 34 to a mixer 753 similar to one shown in FIG. 63. The low frequency signal of PSK or QAM mode in a given channel of the satellite TV system is transferred to a [modulator] <u>demodulator</u> 35 where two data streams D_1 and D_2 are reproduced from the signal. D_1 and D_2 are sent through a divider 788 to a second video decoder 422 where they are converted to a video signal which is then delivered from an output unit 780. Also, a digital or analogue terrestrial TV signal intercepted by a terrestrial antenna 32a is fed through an input unit 752 to the mixer 753 where one desired channel is selected in the same manner as described in FIG. 63 and converted into [to] a low frequency base band signal. The signal of analogue form is sent directly to the demodulator 35 for demodulation. The signal of digital form is then fed to a discrimination/demodulation circuit 757 where two data streams D_1 and D_2 are reproduced from the signal. D_1 and D_2 are converted by the second video decoder 422 into a video signal which is then delivered further. A satellite analogue TV signal is transferred to a video demodulator [788] <u>7880</u> where it is [AN] <u>AM</u> modulated into an analogue video signal which is then delivered from the output unit 780. As understood, the mixer 753 of the TV receiver 781 shown in FIG. 67 is arranged to be compatible between two, satellite and terrestrial, broadcast services. Also, a receiver circuit including a detector 755 and an LPF 756 for

AM modulation of an analogue signal can be utilized compatible with a digital ASK signal of the terrestrial TV [serivice] service. The major part of the arrangement shown in FIG. 67 is arranged for compatible use, thus minimizing a circuitry construction.

Please amend the paragraph beginning in Column 50, line 54 as follows:

According to the embodiment, a 4-level ASK signal is divided into two, D_1 and D_2, level components for execution of the one-bit mode multi-level signal transmission. If an 8-level [ASk] ASK signal as shown in FIGS. 68(a) and (b) illustrating the constellation of the 8-VSB signal, i.e., 8-level VSB signal is used, it can be transmitted in a one-bit mode three-level, D_1, D_2, and D_3, arrangement, thus, three bits [pre] per symbol in total. A shown in FIG. 68(a), the first bit coding is done as follows. D_3 is assigned to eight signal points 721a and 721b; 722a and 722b; 723a and 723b; and 724a and 724b, each pair, i.e., small group, representing a two-level pattern using one bit. Next, the second bit coding is done as follows. D_2 is assigned to two signal point groups 721 and 722; and 723 and 724, two mid groups representing a two-level pattern using one bit. Next, the third bit coding is done as follows. D_1, is assigned to two large signal point groups 725 and 726 representing a two-level pattern using one bit. More particularly, this is equivalent to a form in which each of the four signal points 721, 722, 723, and 724 shown in FIG. 57 is divided into two components thus [producint] producing, at the maximum, three different level data.

Please amend the paragraph beginning in Column 51, line 26 as follows:

While the transmitted data quantity is high with 8-level VSB, it also has a higher error rate than 4-level VSB for the same C/N value. However, in high image quality HDTV transmissions, the available transmission capacity makes it possible to apply more error correction coding, and the error rate can thus be reduced. This band capacity also [enable] enables multi-level (hierarchical) television broadcasts and other new features in the future.

Please amend the paragraph beginning in Column 51, line 48 as follows:

With 8-level VSB, the effective data transmission quantity is 5 MHz x 6=30 Mbps because the frequency utilization efficiency is 5 bits/Hz. While 15 Mbps-18 Mbps is required for digital HDTV signal transmission as described above, when using 8-level VSB modulation, more than 50% of the actual HDTV signal transmission quantity can be used for error correction coding as shown in FIG. 169. As shown by error rate curves 805 and 806 in FIG. [161] <u>163</u>, the error rate relative to the same C/N value in the transmission system is less with TCM 8-level VSB than with 4-level VSB, even through error correction code gain is greater with 8-level VSB than with 4-level VSB, because significantly more error correction coding can be added with 8-level VSB during ground station broadcasting of same-data-rate HDTV digital signals using the 6-MHz band. As a result, 8-level VSB with high code gain error correction coding also has the effect of enabling a larger service area for ground station HDTV broadcasts than does 4-level VSB. While the increased size of the error correction circuits required with 8-level VSB does increase the complexity of the receiver circuitry, the circuit scale of the equalizer in the receiver is significantly smaller than that of receivers using QAM modulation, which contains a phase component, because VSB and ASK are amplitude modulation methods. As a result, an 8-level VSB circuit board containing the error correction circuit is smaller than an equivalent 32-level QAM board with the same transmission capacity.

Please amend the paragraph beginning in Column 52, line 35 as follows:

Code gain can be further increased and the error rate decreased by using a trellis encoder as shown in FIGS. 128(a), (b), (c), (d), (e), and (f). A ratio 2/3 trellis encoder [744b] <u>743c</u> and decoder 759b as shown in FIG. 172 are most appropriate with 8-level VSB because of 3 bits/symbol coding. The data quantity is compressed 2/3 in this case.

Please amend the paragraph beginning in Column 53, line 40 as follows:

In particular, the arrangement of the video encoder 401 of the third embodiment shown in FIG. 30 is replaced by a modification of the block diagram of FIG. 69. The operation of the modified arrangement is similar and will not be explained in greater detail. Two video signal divider circuits

404 and 404a which may be sub-band filters are provided forming a divider unit 794. The divider unit 794 may also be arranged more [simple a] <u>simply as</u> shown in the block diagram of FIG. 70, in which a signal passes across one signal divider circuit two times at time division mode. More specifically, a video signal of e.g. HDTV or super HDTV from the input unit 403 is time-base compressed by a time-base compressor 795 and fed to the divider circuit 404 where it is divided into four components, H_HV_H-H, H_HV_L-H, and H_LV_H-H, and H_LV_L-H, at a first cycle. At the time, four switches 765, 765a, 765b, and 765c remain turned to the position 1 so that H_HV_H-H, H_HV_L-H, and H_LV_H-H, are transmitted to a compressing circuit 405. Meanwhile, H_LV_L-H is fed back through the terminal 1 of the switch 765c to the time-base compressor 795. At a second cycle, the four switches 765, 765a, 765b, and 765c turned to the position 2 and all the four components of the divider circuit 404 are simultaneously transferred to the compressing circuit 405. Accordingly, the divider unit [769] <u>794</u> of FIG. 70 arranged for time division processing of an input signal can be constructed in a simpler dividing circuit form.

Please amend the paragraph beginning in Column 54, line 5 as follows:

Also, the third video decoder 423 may be modified in which the same action is executed with one single mixer 556 as shown in FIG. 72. At the first timing, five [swatches] <u>switches</u> 765, 765a, 765b, 765c, 765d remains turned to the position 1. Hence, H_LV_L, H_LV_H, H_HV_L, and H_HV_H are fed from a first 522, a second 522a, a third 522b and a fourth expander 522c [to] through their respective switches to the mixer 556 where they are mixed to a single video signal. The video signal which represents H_L V_L-H of an input high resolution video signal is then fed back through the terminal 1 of the switch 765d to the terminal 2 of the switch 765c. At the second timing, the four switches 765, 765a, 765b, 765c are turned to the point 2. Thus, H_HV_H-H, H_HV_L-H, H_LV_H-H, and H_LV_L-H are transferred to the mixer 556 where they are mixed to a single video signal which is then sent across the terminal 2 of the switch 765d to the output unit 554 for further delivery.

Please amend the paragraph beginning in Column 54, line 30 as follows:

If the four components [are] overlap each other or are supplied in a variable sequence, they have to be time-base adjusted to a given sequence through using memories accompanied with their respective switches 765, 765a, 765b, and 765c. In the foregoing manner, a signal is transmitted from the transmitter at two different timing periods as shown in FIG. 73 so that no time-base controlling circuit is needed in the receiver which is thus arranged more [compact] <u>compactly</u>.

Please amend the paragraph beginning in Column 54, line 38 as follows:

As shown in FIG. 73, D_1 is the first data stream of a transmitting signal and H_LV_L, $H_L V_H$, H_HV_L, and H_HV_H are transmitted on D_1 channel at the period of first timing. Then, at the period of second timing, H_LV_H and H_HV_H, are transmitted on D_2 channel. As the signal is transmitted in a time division sequence, the encoder in the receiver can be arranged more [simple] <u>simply</u>.

Please amend the paragraph beginning in Column 55, line 26 as follows:

Here, as shown by the block diagrams of FIGS. 156 and 170, a logic level arrangement based on discrimination in the error correction capability as described in the second embodiment is added to 4 VSB or 8 VSB. More particularly, H_LV_L is carried on D_{1-1} channel of the D_1 signal. The D_{1-1} channel is higher in the error correction capability than D_{1-2} channel, as described in the second embodiment. The D_{1-1} channel is higher in the redundancy but lower in the error rate than the D_{1-2} channel and the [date] <u>data</u> 821 can be reconstructed at a lower C/N rate than that of the other data 821a, 821b, and 821c. More specifically, a low resolution NTSC component will be reproduced at a far location from the transmitter antenna or in a signal attenuating or shadow area, e.g. the interior of a vehicle.

Please amend the paragraph beginning in Column 55, line 60 as follows:

[FIGS.] <u>FIG.</u> 78 is a block diagram of the third video decoder arranged for the time-base assignment of data shown in FIG. 77, which is similar to that shown in FIG. 72 except that the third

input 551 for D_3 signal is eliminated and the arrangement shown in FIG. 74(a) is added.

Please amend the paragraph beginning in Column 57, line 8 as follows:

Also, FSK modulation will be eligible in any of the embodiments. For example, the signal points of a multiple-level FSK signal consisting of four frequency components [F1] f1, f2, f3, and f4 are divided into groups as shown in FIG. 58 and when the distance between any two groups are spaced from each other for ease of discrimination, the multi-level transmission of the FSK signal can be implemented, as illustrated in FIG. 83.

Please amend the paragraph beginning in Column 57, line 35 as follows:

While the transmitted data quantity is high with 8-level VSB, it also has a higher error rate than 4-level VSB for the same C/N value. However, in high image quality HDTV transmissions, the available transmission capacity makes it possible to apply more error correction coding, and the error rate can thus be reduced. This band capacity also [enable] enables multi-level (hierarchical) television broadcasts and other new features in the future.

Please amend the paragraph beginning in Column 57, line 57 as follows:

With 8-level VSB, the effective data transmission quantity is 5 MHz x 6=30 Mbps because the frequency utilization efficiency is 5 bits/Hz. While 15 Mbps-18 Mbps is required for digital HDTV signal transmission as described above, when using 8-level VSB modulation, more than 50% of the actual HDTV signal transmission quantity can be used for error correction coding as shown in FIG. 169. As shown by error rate curves 805 and 806 in FIG. [161] 163, the error rate relative to the same C/N value in the transmission system is less with TCM 8-level VSB than with 4-level VSB, even through error correction code gain is greater with 8-level VSB than with 4-level VSB, because significantly more error correction coding can be added with 8-level VSB during ground station broadcasting of same-data-rate HDTV digital signals using the 6-MHz band. As a result, 8-level VSB with high code gain error correction coding also has the effect of enabling a larger service area for ground station HDTV broadcasts than does 4-level VSB. While the increased size of the error

correction circuits required with 8-level VSB does increase the complexity of the receiver circuitry, the circuit scale of the equalizer in the receiver is significantly smaller than that of receivers using QAM modulation, which contains a phase component, because VSB and ASK are amplitude modulation methods. As a result, an 8-level VSB circuit board containing the error correction circuit is smaller than an equivalent 32-level QAM board with the same transmission capacity.

Please amend the paragraph beginning in Column 58, line 44 as follows:

Code gain can be further increased and the error rate decreased by using a trellis encoder as shown in FIGS. 128(a), (b), (c), (d), (e), and (f). A ratio 2/3 trellis encoder [744b] 743c and decoder 759b as shown in FIG. 172 are most appropriate with 8-level VSB because of 3 bits/symbol coding. The data quantity is compressed 2/3 in this case.

Please amend the paragraph beginning in Column 58, line 65 as follows:

Four- and 8-level VSB have been described above, and 16- and 32-level VSB are described below with reference to FIGS. 159(a)-(b). FIG. 159(a) shows the 16-level VSB constellation. As shown in FIG. 159(b), the signal between two signal points is grouped into eight groups 722a-722h, which are treated as eight signal points and can be treated as 8-level VSB signals to enable a two-stage multilevel transmission. In this case, multilevel transmission can be [achieves] achieved with time division multiplexing even when intermittently transmitting an 8-level VSB signal. The maximum data rate with this method is 2/3. In FIG. [157(c)] 159(c), the data is further grouped into four groups 723a-723d, which can be handled as 4-level VSB signals adding one more level to the hierarchy. While the maximum data rate drops with time division multiplex transmission of 4-level VSB signals, multilevel transmission is possible with 3-stage multilevel VSB transmission.

Please amend the paragraph beginning in Column 60, line 62 as follows:

FIG. 177 is a block diagram showing a Trellis decoder in the demodulator. The Trellis [encoder] decoder 759b explained with FIG. 84 may change the coding [grain] gain according to the level of the transmitter side and the conditions of a transmission line. Hence, a corresponding Trellis

decoder is needed in the receiver side.

Please amend the paragraph beginning in Column 61, line 14 as follows:

This arrangement allows the single Trellis decoder 1030 associated with the plural memories to perform multiple characteristics as acting as a number of the Trellis decoders. Thus, the demodulator will be reduced in the hardware construction as compared with a conventional circuit arrangement where a plurality of the Trellis decoders are coupled in parallel for selective use.

Please amend the paragraph beginning in Column 62, line 34 as follows:

A sixth embodiment of the present invention is a magnetic recording and playback apparatus in which the above transmission and recording method is employed. Although in the fifth embodiment a multiple-level ASK data transmission is described, [but] it is also feasible in the same manner to adopt this invention in a magnetic recording and playback apparatus of a multi-level ASK recording system as shown in the block diagram of FIG. 173. A multi-level or non-multilevel magnetic recording can be realized by applying the C-CDM method of the present invention to PSK, FCK, and QAM, as well as ASK.

Please amend the paragraph beginning in Column 62, line 55 as follows:

[AS] As shown in FIG. 84, an input video signal, e.g. an HDTV signal, to a magnetic record/playback apparatus 851 is divided and compressed by a video encoder 401 into a low frequency band signal through a first video encoder 401a and a high frequency band signal through a second video encoder 401b respectively. Then, a low frequency band component, e.g. $H_L V_L$, of the video signal is fed to a first data stream input 743 of an input unit 742 and a high frequency band component including $H_H V_H$ is fed to a second data stream input 744 of the same. The two components are further transferred to a modulator 749 of a modulator[/demodulator] unit [852] 852a. The first data stream input 743 adds an error correcting code to the low frequency band signal in an ECC 743a. On the other hand, the second data stream fed into the second data stream input 744 is 2 bit in case of 16 SRQAM, 3 bit in case of 36 SRQAM, and 4 bit in case of 64 SRQAM. After an

error correcting code is encoded by an ECC 744a, this signal is supplied to a Trellis encoder 744b, such as shown in FIGS. 128(a), (b), (c) in which a Trellis encoded signal having a ratio ½ in case of 16 SRQAM, 2/3 in case 32 SRQAM, and 3/4 in case of 64 SRQAM, is produced. A 64 SRQAM signal, for example, has a first data stream of 2 bit and a second data stream of 4 bit. A Trellis encoder 744b of FIG. 128(c) allows this 64 SRQAM signal to perform a Trellis encoding of ratio 3/4 wherein 3 bit data is converted into 4 bit data. In the case of 4 ASK, 8 ASK, and 16 ASK, the Trellis encoding at the ratio of 1/2, 2/3, and 4/3 can be carried [our] <u>out</u> solely. Thus, redundancy increases and a data rate decreases, while error correcting capability increases. This results in the reduction of an error [rate-in] <u>rate in</u> the same data rate. Accordingly, transmittable information amount of the recording/playback system or transmission system will increase substantially.

Please amend the paragraph beginning in Column 63, line 29 as follows:

It is, however, possible to constitute the first data stream input 743 not to include a Trellis encoder as shown in FIG. 84 of this sixth embodiment because the first data stream has low error rate inherently. This will be advantageous in view of the simplification of circuit configuration. The second data stream, however, has a narrow inter-code distance as compared with the first data stream and, therefore, has a worse error rate. The Trellis encoding of the second data stream improves such a worse error rate. It is no doubt that an overall circuit configuration becomes simple if the Trellis encoding of the first data stream is eliminated. An operation for modulation is almost identical to that of the transmitter of the fifth embodiment shown in FIG. 64 and will [be] not be explained in greater detail. A modulated signal of the modulator 749 is fed into a recording/playback circuit 853 in which it is AC biased by a bias generator 856 and amplified by an amplifier 857a. Thereafter, the signal is fed to a magnetic head [854] <u>854b</u> for recording onto a magnetic tape 855.

Please amend the paragraph beginning in Column 63, line 62 as follows:

A main signal of 16 SRQAM will have a signal point assignment shown in FIG. 10. Furthermore, a main signal of 36 SRQAM will have a signal point assignment shown in FIG. 100. When 4 ASK, 8 ASK are used, the constellation will be as shown in FIGS. 58, 68(a) and (b). In

reproduction of this signal, both the main signal 859 and the pilot signal 859a are reproduced through the magnetic head [854] 854a and amplified by an amplifier 857b. An output signal of the amplifier 857b is fed to a carrier reproduction circuit 858 in which a filter 858a separates the frequency of the pilot signal f_p having a frequency [2f0] $2f_0$ and ½ frequency divider 858b reproduces a carrier of frequency [f0] f_0 to transfer it to a demodulator 760. This reproduced carrier is used to demodulate the main signal in the demodulator 760. Assuming that a magnetic recording tape 855, e.g. HDTV tape, is of a high C/N rate, 16 signal points are discriminatable and thus both D_1 and D_2 are demodulated in the demodulator 760. Subsequently, a video decoder 402 [reproduce] reproduces all the signals. An HDTV VCR can reproduce a high bit-rate TV signal such as 15 Mbps HDTV signal. The [low] lower the C/N rate is, the cheaper the cost of a video tape is. So far, a VHS tape in the market is inferior more than 10 dB in C/N rate to a full-scale broadcast tape. If a video tape 855 is of low C/N rate, it will not be able to discriminate all the 16 or 32 valued signal points. Therefore the first data stream D_1 can be reproduced, while a 2 bit, 3 bit, or 4 bit data stream of the second data stream D_2 cannot be reproduced. Only 2 bit data stream of the first data stream is reproduced. If a two-level HDTV video signal is recorded and reproduced, a low C/N tape having insufficient capability of reproducing a high frequency band video signal can output only a low rate low frequency band video signal of the first data stream, specifically e.g. a 7 Mbps wide NTSC TV signal.

Please amend the paragraph beginning in Column 64, line 28 as follows:

As shown in a block diagram of FIG. 144, a second data stream output 759, the second data stream input 744, and the second video decoder 402a can be eliminated in order to provide customers one aspect of lower grade products. In this case, a recording/playback apparatus 851, dedicated to a low bit rate, will include a modulator such as a modulated QPSK which modulates or demodulates the first [date] data stream only. This apparatus allows only the first data stream to be recorded and reproduced. Specifically, a wide NTSC grade video signal can be recorded and reproduced.

Please amend the paragraph beginning in Column 64, line 38 as follows:

Above-described high C/N rate video tape 855 capable of recording a high bit-rate signal, e.g. HDTV signal, will be able to [use] be used in such a low bit-rate dedicated magnetic recording/playback apparatus but will reproduce the first data stream D_1 only. That is, the wide NTSC signal is outputted, while the second data stream is not reproduced. In other words, one recording/playback apparatus having a complicated configuration can reproduce [a] an HDTV signal and the other recording/playback apparatus having a simple configuration can reproduce a wide NTSC signal if a given video tape 855 includes the same multi-level HDTV signal. Accordingly in case of two-level multiple state, four combinations will be realized with [prefect] perfect compatibility among two tapes having different C/N rates and two recording/playback apparatus having different recording/playback data rates. This will bring a remarkable effect. In this case, an NTSC dedicated apparatus will be simple in construction as compared with an HDTV dedicated apparatus. In more detail, a circuitry scale of [ECTV] EDTV decoder will be 1/6 of that of HDTV decoder. Therefore, a low function apparatus can be realized at fairly low cost. Realization of two, HDTV and EDTV, types recording/playback apparatus having different recording/reproducing capability of picture quality will provide various type products ranging in a wide price range. Users can freely select a tape among a plurality of tapes from an expensive high C/N rate tape to a cheaper low C/N rate tape, as occasion demands so as to satisfy required picture quality. Not only maintaining perfect compatibility but obtaining expandable capability will be attained and further compatibility with a future system will be ensured. Consequently, it will be possible to establish long-lasting standards for recording/playback apparatus. Other recording methods will be used in the same manner. For example, a multi-level recording will be realized by use of phase modulation explained in the first and third embodiments. A recording using ASK explained in the fifth embodiment will also be possible. A two or three multi-level state will be realized by converting present recording from two-level to four-level ASK or to eight-level ASK and dividing into two group as shown in FIGS. 59(c) and 59(d) or in FIGS. 68(a) and 68(b).

Please amend the paragraph beginning in Column 65, line 11 as follows:

A circuit block diagram for ASK [will be as] is shown in FIG. 173 which is similar to that disclosed in FIG. 84. By the combination of Trellis and ASK, the error rate will be reduced. Besides embodiments already described, a multi-level recording will be also realized by use of multiple tracks on a magnetic [type] tape. Furthermore, a theoretical multi-level recording will be feasible by differentiating the error correcting capability so as to discriminate respective data.

Please amend the paragraph beginning in Column 65, line 19 as follows:

Compatibility with future standards will be described below. A setting of standards for recording/playback apparatus such as VCR is normally done by taking account of the [most] highest C/N rate tape available in practice. The recording characteristics of a tape progresses rapidly. For example, the C/N rate has been improved more than 10 dB compared with the tape used 10 years ago. If it is supposed that new standards will be established after 10 to 20 years due to an advancement of tape property, a conventional method will encounter with difficulty in maintaining compatibility with older standards. New and old standards, in fact, used to be one-way compatible or non-compatible with each other. On the contrary, in accordance with the present invention, the standards are first of all established for recording and/or reproducing the first data stream and/or second data stream on present day tapes. Subsequently, if the C/N rate is improved magnificently in future, an upper level data stream, e.g. a third data stream, will be added without any difficulty as long as the present inventions incorporated in the system. For example, a super HDTV VCR capable of recording or reproducing three-level 64 SRQAM or 8 ASK will be realized while maintaining perfect compatibility with the conventional standards. A magnetic tape, recording first to third data streams in compliance with new standards, will be able to use, of course, in the older two-level magnetic recording/playback apparatus capable of recording and/or reproducing only first and second data streams. In this case, first and second data streams can be reproduced perfectly although the third data stream is left non-reproduced. Therefore, an HDTV signal can be reproduced. For these reasons, the merit of expanding recording data amount while maintaining compatibility between new

and old standards is expected.

Please amend the paragraph beginning in Column 65, line 52 as follows:

Returning to the explanation of reproducing operation of FIG. 84, the magnetic head [854] <u>854a</u> and the magnetic reproduction circuit [853] <u>858</u> reproduce a reproducing signal from the magnetic tape 855 and [feeds] <u>feed</u> it to [the modulation/demodulation circuit 852] <u>a demodulator unit 852b</u>. The demodulating operation is almost identical with that of first, third, and fourth embodiments and will no further be explained. The demodulator 760 reproduces the first and second data stream D_1 and D_2. The second data stream D_2 is error corrected with high code gain in a Trellis-decoder 759b such as a Vitabi decoder, so as to be low error rate. The video decoder 402 demodulates D_1 and D_2 signals to output an HDTV video signal.

Please amend the paragraph beginning in Column 66, line 17 as follows:

In playback operation, a recording signal reproduced through the magnetic head 854 is demodulated into D_1 and D_2 by the C-CDM demodulator 760 in the same manner as in the explanation of FIG. 84. The first data stream D_1 is demodulated into two, D_{1-1} and D_{1-2}, subchannels through the TDM 758c provided in the first data stream output 758. D_{1-1} data is error corrected in an ECC decoder 758a having high code gain. Therefore, D_{1-1} data can be demodulated at a lower C/N rate as compared with D_{1-2} data. A 1-1 video decoder 402a decodes the D_{1-1} data and outputs an LDTV signal. On the other hand, D_{1-2} data is error corrected in an ECC decoder [75 8b] <u>758b</u> having normal code gain. Therefore, D_{1-2} data has a threshold value of high C/N rate compared with D_{1-1} data and thus will not be demodulated when a signal level is not large. D_{1-2} data is then demodulated in a 1-2 video decoder [4 02d] <u>4 02d</u> and summed with D_{1-1} data to output an EDTV signal of wide NTSC grade.

Please amend the paragraph beginning in Column 66, line 34 as follows:

The second data stream D_2 is Vitabi demodulated in a Trellis decoder 759b and error corrected at an ECC decoder [7 59a] <u>759a</u>. Thereafter, D_2 data is converted into a high frequency

band video signal through a second video decoder 402b and, then, summed with D_{1-1} and D_{1-2} data to output an HDTV signal. In this case, a threshold value of the C/N rate of D_2 data is set larger than that of C/N rate of D_{1-2} data. Accordingly, D_{1-1} data, i.e. an LDTV signal, will be reproduced from a tape 855 having a smaller C/N rate. D_{1-1} and D_{1-2} data, i.e. an EDTV signal, will be reproduced from a tape 855 having a normal C/N rate. And, D_{1-1}, D_{1-2}, and D_2, i.e. an HDTV signal, will be reproduced from a tape 855 having a high C/N rate.

Please amend the paragraph beginning in Column 67, line 4 as follows:

A fast feed reproduction in a reverse direction does not allow a magnetic head trace 855f having an azimuth angle A to coincide with the magnetic track as shown in the drawing. As the present invention provides the D_{1-1} recording region [8 55c] <u>855c</u> at a central narrow region of the magnetic tape as shown in FIG. 132, this region only is surely reproduced although it occurs at a predetermined probability. Thus reproduced D_{1-1} signal can demodulate an entire picture plane of the same time although its picture quality is an LDTV of MPEG1 level. In this manner several to several tens LDTV signals per second can be reproduced with perfect picture images during the fast feed playback operation, thereby enabling users to surely confirm picture images during the fast feed operation.

Please amend the paragraph beginning in Column 67, line 32 as follows:

Next, another method will be described to respond a higher speed fast feed playback operation. A D_{1-1} recording region 855c is provided as shown at lower right of FIG. 132, so that one frame of LDTV signal is recorded thereon. Furthermore, a narrow $D_{1-1} \cdot D_2$ recording region 855h is provided at a part of the D_{1-1} recording region 855c. A subchannel D_{1-1} in this region records a part of information relating to the one frame of LDTV signal. The remainder of the LDTV information is recorded on the D_2 recording region 855j of the $D_{1-1} \cdot D_2$ recording region 855h in a duplicated manner. The subchannel D_2 has a data recording capacity 3 to 5 times as much as the subchannel D_{1-1}. Therefore, subchannels D_{1-1} and D_2 can record one frame information of LDTV signal on a smaller, [1/3 ?i /5] <u>1/3 ~ 1/5</u>, area of the recording tape. As the head trace can be recorded in a further

narrower regions 855h, 855j, both time and area are decreased into [1/3 ?i /5] 1/3 ~ 1/5 as compared with a head trace time T_{S1}. Even if the trace of head is further inclined by increasing fast feed speed amount, the probability of entirely tracing this region will be increased. Accordingly, perfect LDTV picture images will be intermittently reproduced even if the fast feed speed is increased up to 3 to 5 times as fast as the case of the subchannel D_{1-1} only.

Please amend the paragraph beginning in Column 68, line 25 as follows:

As it is described in the foregoing description, the magnetic recording/playback apparatus in accordance with the present invention can reproduce picture images consisting of the same content even if C/N rate is low or error rate is high, although the resolution or the picture quality is relatively low.

Please amend the paragraph beginning in Column 68, line 53 as follows:

FIG. 93 is a block diagram of a divider circuit 3 which comprises a video divider 895 and four compressors 405a, 405b, 405c, and 405d. The video divider 895 contains three dividers 404a, 404b, and 404c which are arranged identical to the divider circuit 404 of the first video encoder 401 shown in FIG. 30 and will [be] not be explained in greater detail. An input video signal is divided by the dividers into four components, $H_L V_L$ of low resolution data, $H_H V_H$ of high resolution data, and $H_L V_H$ and $H_H V_L$ for medium resolution data. The resolution of $H_L V_L$ is a half that of the original input signal.

Please amend the paragraph beginning in Column 68, line 64 as follows:

The input video signal is first divided by the divider [4 04a] 404a into two, high and low, frequency band components, each component being divided into two, horizontal and vertical, segments. The intermediate between the high and low frequency ranges is a dividing point according to the embodiment. Hence, if the input video signal is an HDTV signal of 1000 line vertical resolution, $H_L V_L$ has a vertical resolution of 500 lines and a horizontal resolution of a half value.

Please amend the paragraph beginning in Column 69, line 19 as follows:

H_L V_H, H_H V_L, and H_H V_H [form] from the divider 404a are mixed by a mixer 772a to an H_H V_H-H signal. If the input signal is as high as 1000 lines in both horizontal and vertical resolution, H_H V_H-H has 500 to 1000 lines of a horizontal and a vertical resolution. H_H V_H-H is fed to the divider 404b where it is divided again into four components.

Please amend the paragraph beginning in Column 69, line 25 as follows:

Similarly, H_L V_L from the divider 404b has 500 to 750 lines of a horizontal and a vertical resolution and transferred as an H_L signal to the compressor 405c. The other three components, H_L V_H, H_H V_L, and H_H V_H, from the divider 404b have 750 to 1000 lines of a horizontal and a vertical resolution and are mixed by a mixer 772b to an HH signal which is then compressed by the compressor 405d and delivered as a [D_{202}] $\underline{D_{2-2}}$ signal. After compression, the HL signal is delivered as a D_{2-1} signal. As the result, LL or D_{1-1} carries a frequency data of 0 to 250 lines, LH or D_{1-2} carries a frequency data from more than 250 lines up to 500 lines, HL or D_{2-1} carries a frequency data of more than 500 lines up to 750 lines, and HH or D_{2-2} carries a frequency data of more than 750 lines to 1000 lines so that the divider circuit 3 can provide a four-level signal. Accordingly, when the divider circuit 3 of the transmitter 1 shown in FIG. 87 is replaced by the divider circuit of FIG. 93, the transmission of a four-level signal will be implemented.

Please amend the paragraph beginning in Column 69, line 54 as follows:

As described in the second embodiment, a received signal after being demodulated and error corrected, is fed as a set of four components D_{1-1}, D_{1-2}, D_{2-1}, and D_{2-2} to the mixer 37 of the second receiver 33 of FIG. 88.

Please amend the paragraph beginning in Column 69, line 58 as follows:

FIG. 94 is a block diagram of a modified mixer 33 in which D_{1-1}, D_{1-2}, D_{2-1}, and D_{2-2} are explained by their respective expanders 523a, 523b, 523c, and 523d to an LL, [and] an LH, an HL, and an HH signal respectively which are equivalent to those described with FIG. 93. If the bandwidth

of the input signal is 1, LL has a bandwidth of 1/4, LL+LH has a bandwidth of 1/2, LL+LH+HL has a bandwidth of 3/4, and LL+LH+HL+HH has a bandwidth of 1. The LH signal is then divided by a divider 531a and mixed by a video mixer 548a with the LL signal. An output of the video mixer 548a is transferred to an H_L V_L terminal of a video mixer 548c. The video mixer 531a is identical to that of the second decoder 527 of FIG. 32 and will not be explained in greater detail. Also, the HH signal is divided by a divider 531b and fed to a video mixer 548b. At the video mixer 548b, the HH signal is mixed with the HL signal to an H_H V_H-H signal which is then divided by a divider 531c and sent to the video mixer 548c. At the video mixer 548c, H_H V_H-H is combined with the sum signal of LH and LL to a video output. The video output of the mixer 33 is then transferred to the output unit 36 of the second receiver shown in FIG. 88 where it is converted to a TV signal for delivery. If the original signal has 1050 lines of vertical resolution or is an HDTV signal of about 1000 -line resolution, its four different signal level components can be intercepted in their respective signal receiving areas shown in FIG. 91.

Please amend the paragraph beginning in Column 70, line 24 as follows:

Also, as shown in FIG. 95, the four different level components LL, LH, HL, and HH are accumulated in proportion to the C/N rate. More specifically, the quality of a reproduced picture will be increased as the distance from a transmitter antenna becomes small. When L=Ld, LL component is reproduced. When L=Lc, LL+LH signal is reproduced. When L=Lb, LL+LH+HL signal is reproduced. When L=La, LL+LH+HL+HH signal is reproduced. As the result, if the bandwidth of the original signal is 1, the picture quality is enhanced at 1/4 increments of bandwidth from 1/4 to 1 depending on the receiving area. If the original signal is an HDTV of 1000-line vertical resolution, a reproduced TV signal is 250, [50 0] <u>500</u>, 750, and 1000 lines in the resolution at their respective receiving areas. The picture quality will thus be varied at steps depending on the level of a signal. FIG. 96 shows the signal propagation of a conventional digital HDTV signal transmission system, in which no signal reproduction will be possible when the C/N rate is less than V0. Also, signal interception will hardly be guaranteed at signal interference regions, shadow regions, and other signal attenuating regions, denoted by the symbol x, of the service area. FIG. 97 shows the signal

propagation of an HDTV signal transmission system of the present invention. As shown, the picture quality will be a full 1000-line grade at the distance La where C/N=a, a 750-line grade at the distance Lb where C/N=b, a 500-line grade at the distance Lc where C/N=c, and a 250-line grade are the distance Ld where C/N=d. Within the distance La, there are shown unfavorable regions where the C/N rate drops sharply and no HDTV quality picture will be reproduced. As understood, a lower picture quality signal can however be intercepted and reproduced according to the multi-level signal transmission system of the present invention. For example, the picture quality will be a 750-line grade at the point B in a building shadow area, a 250-line grade at the point D in a running train, a 750-line grade at the point F in a ghost developing area, a 250-line grade at the point G in a running car, a 250-line grade at the point L in a neighbor signal interference area. As set forth above, the signal transmission system of the present invention allows a TV signal to be successfully received at a grade in the area where the conventional system is poorly qualified, thus increasing its service area. FIG. 98 [shown] <u>shows</u> an example of simultaneous broadcasting of four different TV programs, in which three quality programs C, B, A are transmitted on their respective channels D_{1-2}, D_{2-1}, D_{2-2} while a program D identical to that of a local analogue TV station is propagated on the D_{1-1} channel. Accordingly, while the program D is kept available at simulcast service, the other three programs can also be distributed on air for offering a multiple program broadcast service.

Please amend the paragraph beginning in Column 71, line 14 as follows:

FIG. 115 is a block diagram showing a transmitter/receiver of a portable telephone, in which a telephone conversation sound inputted across a microphone [76 2] <u>762</u> is compressed and coded in a compressor 405 into multi-level, D_1, D_2, and D_3, data previously described. These D_1, D_2, and D_3 data are time divided in a time division circuit 765 into predetermined time slots and, then, modulated in a modulator 4 into a multi-level, e.g. SRQAM, signal previously described. Thereafter, an antenna sharing unit 764 and an antenna 22 transmit a carrier wave carrying a modulated signal, which will be intercepted by a base station later described and further transmitted to other base stations or a central telephone exchanger so as to communicate with other telephones.

Please amend the paragraph beginning in Column 71, line 38 as follows:

FIG. 116 shows a block diagram exemplarily showing an arrangement of base stations, in which three base stations [7 71] 771, 772, and 773 locate at center of respective receiving cells 768, 769, and 770 of hexagon or circle. These base stations 771, 772, and 773 respectively [has] have a plurality of transmitter/receiver units 761a~761j each similar to that of FIG. 115 so as to have data communication channels equivalent to the number of these transmitter/receiver units. A base station controller 774 is connected to all the base stations and always monitors a communication traffic amount of each base station. Based on the monitoring result, the base station controller 774 carries out an overall system control including allocation of channel frequencies to respective base stations or control of receiving cells of respective base stations.

Please amend the paragraph beginning in Column 71, line 53 as follows:

FIG. 117 is a view showing a traffic distribution of communication amount in a conventional, e.g. QPSK, system. A diagram d=A shows data 774a and 774b having frequency utilization efficiency 2 bit/Hz, and a diagram d=B shows data 774c of frequency utilization efficiency 2 bit/Hz. A summation of these data 774a, 774b, and 774c becomes [a] data 774d, which represents a transmission amount of Ach consisting of receiving cells 768 and 770. Frequency utilization efficiency of 2 bit/Hz is uniformly distributed. However, density of population in an actual urban area is locally high in several crowded areas 775a, 775b, and 775c which includes buildings concentrated. [A data] Data 774e representing a communication traffic amount shows several peaks at locations just corresponding to these crowded areas 775a, 775b, and 775c, in contrast with other areas having a small communication amount. A capacity of conventional cellular telephone was uniformly set to 2 bit/Hz frequency efficiency at entire region as shown by the data 774d irrespective of actual traffic amount TF shown by the data 774e. It is not [not] effective to give the same frequency efficiency regardless of actual traffics amount. In order to compensate for this ineffectiveness, the conventional systems have allocated many frequencies to the regions having a large traffic amount, increased channel number, or decreased the receiving cells thereof. However, an increase of channel number is restricted by the frequency spectrum. Furthermore, conventional multi-level; e.g. 16 QAM or 64

QAM, mode transmission systems increase transmission power. A reduction in the receiving cells will induce an increase in number of base stations, thus increasing installation cost.

Please amend the paragraph beginning in Column 72, line 19 as follows:

It is ideal for the improvement of an overall system efficiency to increase the frequency efficiency of the region having a larger traffic amount and decrease the frequency efficiency of the region having a smaller traffic amount. A multi-level signal transmission system in accordance with the present invention realizes this ideal modification. This will be explained with reference to FIG. 118 showing a communication amount [&] and traffic distribution in accordance with the eighth embodiment of the present invention.

Please amend the paragraph beginning in Column 72, line 57 as follows:

Transmitting/receiving operation of a mobile station capable of responding to a 64 SRQAM signal is carried out by use of modified QPSK, which is obtained by [set] setting a shift amount of SRQAM to S=1, at the place far from the base station, by use of 16 SRQAM at a place not so far from the same, and 64 SRQAM at the near place. Accordingly, the maximum transmission power does not increase as compared with QPSK.

Please amend the paragraph beginning in Column 73, line 38 as follows:

The present invention, which is characterized by a multi-level, e.g. 64 SRQAM, signal transmission system, allows to have three-level data consisting of D_1, D_2, and D_3 of 2 bit/Hz as shown in FIG. 119(b). As both the A_1 and A_2 data are transmitted by 16 SRQAM, their time slots have two times the data rate as shown by slots 782b and 782c and 783b and 783c. It means the same quality sound can be transmitted half the time. Accordingly, a time width of respective time slots [782] 782b and 782c becomes halved. In this manner, two times the transmission capacity can be acquired at the two-level region 776c shown in FIG. 118, i.e. at the vicinity of the base station.

Please amend the paragraph beginning in Column 74, line 10 as follows:

On the contrary, 16 SRQAM mode of the present invention uses a time slot 788a for reception of A_1 channel and a time slot 788c for transmission to A1 channels as shown in FIG. [1 20(b)] 120(b). A width of the time slot becomes approximately 1/2. In case of 64 SRQAM mode, a time slot 788i is used for reception of D_1 channel and a time slot 788l is used for transmission to D_1 channel. A width of the time slot becomes approximately 1/3.

Please amend the paragraph beginning in Column 74, line 45 as follows:

Hereinafter, a ninth embodiment of the present invention will be described referring to the drawings. The ninth embodiment employs this invention in an OFDM transmission system. FIG. 123 is a block diagram of [a] an OFDM transmitter/receiver, and FIG. 124 is a diagram showing a principle of an OFDM action. An OFDM is one of FDM and has a better efficiency in frequency utilization as compared with a general FDM, because an OFDM sets adjacent two carriers to be quadrate with each other. Furthermore, OFDM can bear multipath obstructions such as ghosts and, therefore, may be applied in the future to the digital music broadcasting or digital TV broadcasting.

Please amend the paragraph beginning in Column 74, line 57 as follows:

As shown in the principle diagram of FIG. 124, OFDM converts an input signal by a serial to parallel converter 791 into a data being disposed on a frequency axis 793 at intervals of 1/ts, so as to produce subchannels [794a~94e] 794a-794e. This signal is inversely FFT converted by a modulator 4 having an inverse FFT 40 into a signal on a time axis [79~9] 799 to produce a transmission signal 795. This inverse FFT signal is transmitted during an effective symbol period 796 of the time period ts. A guard interval 797 having an amount tg is provided between symbol periods.

Please amend the paragraph beginning in Column 75, line 3 as follows:

A transmitting/receiving action of HDTV signal in accordance with this ninth embodiment will be explained referring to the block diagram of FIG. 123, which shows a hybrid OFDM-CCDM system. An inputted HDTV signal is separated by a video encoder 401 into [three-level] three-levels,

a low frequency band D_{1-1}, a medium-low frequency band D_{1-2}, and a high-medium-low frequency band D_2, video signals, and fed into an input section.

Please amend the paragraph beginning in Column 75, line 28 as follows:

The C-CDM modulators 4a, 4b, 4c—respectively [produces] produce 16 SRQAM signal on the basis of D_1 data of the first data stream input and D_2 data of the second data stream input. These n pieces of C-CDM modulator respectively [has] have a carrier different from each other. As shown in FIG. 124, carriers [79 4a] 794a, 794b, 794c,—are arrayed on the frequency axis 793 so that adjacent two carriers are 90°-out-of-phase with each other. Thus C-CDM modulated n pieces of modulated signal are fed into the inverse FFT circuit 40 and mapped from the frequency axis dimension 793 to the time axis dimension [790] 799. Thus, time signals 796a, 796b—, having an effective symbol length ts, are produced. There is provided a guard interval zone 797a of Tg seconds between the effective symbol time zones 796a and 796b, in order to reduce multipath obstruction. FIG. 129 is a graph showing a relationship between time axis and signal level. The guard time Tg of the guard interval band 797a is determined by taking account of multipath affection and usage of signal. By setting the guard time Tg longer than the multipath affected time, e.g. TV ghost, modulated signals from the inverse FFT circuit 40 are converted by a parallel to serial converter 4e into one signal and, then, transmitted from a transmitting circuit 5 as an RF signal.

Please amend the paragraph beginning in Column 76, line 17 as follows:

The D_2 signal is Trellis decoded by a Trellis decoder [75 9b] 759b and converted by a second video decoder 402b into a high frequency band signal and outputted as an HDTV signal. Namely, an LDTV signal is outputted in case of the low frequency band signal only. An EDTV signal of a wide NTSC grade is outputted if the medium frequency band signal is added to the low frequency band signal, and an HDTV signal is produced by adding low, medium, and high frequency band signals. As well as the previous embodiment, a TV signal having a picture quality depending on a receiving C/N rate can be received. Thus, the ninth embodiment realizes a novel multi-level signal transmission

system by combining an OFDM and a C-CDM, which was not obtained by the OFDM alone.

Please amend the paragraph beginning in Column 76, line 31 as follows:

An OFDM is certainly strong against multipath such as TV ghost because the guard time Tg can absorb an interference signal of multipath. Accordingly, the OFDM is applicable to the digital TV broadcasting for automotive vehicle TV receivers. Meanwhile, no OFDM signal is received when the C/N rate is less than a predetermined value because its signal transmission pattern is [non] <u>not</u> of a multi-level type.

Please amend the paragraph beginning in Column 76, line 39 as follows:

However the present invention can solve this disadvantage by combining the OFDM with the C-CDM, thus realizing a [graditional] <u>gradational</u> degradation depending on the C/N rate in a video signal reception without being disturbed by multipath.

Please amend the paragraph beginning in Column 76, line 44 as follows:

When a TV signal is received in a compartment of <u>a</u> vehicle, not only the reception is disturbed by multipath but the C/N rate is deteriorated. Therefore, the broadcast service area of a TV broadcast station will not be expanded as expected if the countermeasure is only for multipath.

Please amend the paragraph beginning in Column 76, line 49 as follows:

On the other hand, a reception of TV signal of at least LDTV grade will be ensured by the combination with the multi-level transmission C-CDM even if the C/N rate is fairly deteriorated. As a picture plane size of an automotive vehicle TV is normally less than 10 inches, a TV signal of an LDTV grade will provide a satisfactory picture quality. Thus, the LDTV grade service area of automotive vehicle TV will <u>be</u> largely expanded. If an OFDM is used in an entire frequency band of HDTV signal, present semiconductor technologies cannot prevent circuitry scale from increasing so far.

Please amend the paragraph beginning in Column 77, line 16 as follows:

On the other hand, a signal received by the receiver 43 is frequency separated in the FDM 40e and then converted into a number of frequency-base signals in an FFT 40a of an OFDM [modulator] demodulator 852d. Thereafter, frequency-base signals are demodulated in respective demodulators 4a, 4b,—and are fed into a parallel to serial converter 882a, wherein a D_{1-1} signal is demodulated. Thus, a D_{1-1} signal of LDTV grade is outputted from the receiver 43.

Please amend the paragraph beginning in Column 77, line 49 as follows:

Accordingly, the method of the present invention, in which OFDM is used only for a low frequency band TV signal as [sown] shown in FIG. 138, can widely reduce the circuit scale of the OFDM to less than 1/10 without losing inherent OFDM effect capable of largely reducing multiple obstruction of LDTV when received at a mobile station such as an automotive vehicle.

Please amend the paragraph beginning in Column 77, line 56 as follows:

Although the OFDM modulation of FIG. 138 is performed only for D_{1-1} signal, it is also possible to modulate both D_{1-1} and [D_{1-1}] $\underline{D_{1-2}}$ by OFDM. In such a case, a C-CDM two-level signal transmission is used for transmission of D_{1-1} and D_{1-2}. Thus, a multi-level broadcasting being strong against multipath will be realized for a vehicle such as an automotive vehicle. Even in a vehicle, the gradational graduation will be realized in such a manner that LDTV and SDTV signals are received with picture qualities depending on receiving signal level or antenna sensitivity.

Please amend the paragraph beginning in Column 78, line 56 as follows:

Next, a method of realizing a multi-level signal transmission in Time-Weighted-OFDM (i.e. TW-OFDM) in accordance with the present invention will be explained. Although the OFDM System is accompanied with the guard time zone t_g as previously described, adverse affects of ghosts will be eliminated if the delay time t_M of the ghost, i.e. multipath, signal satisfies the requirement of $t_M<t_g$. The delay time t_M will be relatively small, for example in the range of several [microsounds] microseconds, in a fixed station such as a TV receiver used for home use. Furthermore, as its value is constant,

cancellation of ghosts will be relatively easily done. On the contrary, reflected waves will increase in case of a mobile station such as a vehicle TV receiver. Therefore, the delay time t_M becomes relatively large, for example in the range of several tens [microsound] microsecond. Furthermore, the magnitude of t_M varies in response to the running movement of the vehicle. Thus, cancellation of ghosts tends to be difficult. Hence, the multi-level signal transmission is key or essential for such a mobile station TV receiver in order to eliminate adverse affection of multipath.

Please amend the paragraph beginning in Column 79, line 10 as follows:

The multi-level signal transmission in accordance with the present invention will be explained below. A symbol contained in the [subcannel] subchannel layer A can be intensified against the ghosts by setting a guard time t_{ga} of the layer A to be larger than a guard time t_{gb} of the layer B as shown in FIG. 146. In this manner, the multi-layer signal transmission can be realized against multipath by use of weighting of guard time. This system is referred to as Guard-Time-Weighted-OFDM (i.e. QTW-OFDM).

Please amend the paragraph beginning in Column 79, line 19 as follows:

If the symbol number of the symbol time Ts is not different in the layer A and in the layer B, a symbol time t_{sa} of the layer A is set to be [larger] smaller than a symbol time t_{sb} of the layer B. With this differentiation, a carrier width Δfa of the carrier A becomes larger than a carrier width Δfb of the carrier B. [(Δfa>Δfb)] (Δfa<Δfb) Therefore, the error rate becomes lower in the demodulation of the symbol of the layer A compared with the demodulation of the symbol of the layer B. Thus, the differentiation of the layer A and B in the weighting of the symbol time Ts can realize a two-layer signal transmission against multipath. This system is referred to as Carrier-Spacing-Weighted-OFDM (i.e. CSW-OFDM).

Please amend the paragraph beginning in Column 80, line 16 as follows:

The smaller the D/U ratio of the receiving signal becomes, the larger the multipath delay time T_M becomes. Because, the reflected wave increases compared with the direct wave. For example, as

shown in FIG. 148, if the D/U ratio is smaller than 30 dB, the delay time T_M exceeds 30 [us] μs because of increase of the reflected wave. Therefore, as can be understood from FIG. 148, it will become possible to receive the signal even in the worst condition if the Tg is set to be larger than 50 [us] μs.

Please amend the paragraph beginning in Column 80, line 25 as follows:

Accordingly, as shown in detail in FIGS. 149(a) and 149(b), three groups of first 801a, second 801b, and third [801 c] 801c layers are assigned in a 2 ms period of 1 sec TV signal. The guard times 797a, 797b, and 797c, i.e. Tga, Tgb, and Tgc, of these three groups are weighted to be, for example, 50 [microsounds] microseconds, 5 [microsounds] microseconds, and 1 [microsound] microsecond, respectively, as shown in FIG. 149(c). Thus, three-layer signal transmission effective to the multipath will be realized as shown in FIG. 150, wherein three layers 801a, 801b, and 801c are provided.

Please amend the paragraph beginning in Column 80, line 35 as follows:

[If the GTW-OFDM is applied to ass the picture quality, it is doubtless]

Please amend the paragraph beginning in Column 80, line 37 as follows:

At the same time, the multi-layer signal transmission effective to C/N ratio can be realized. By combining the CSW-OFDM and the CSW-OFDM, a two-dimensional multi-layer signal transmission is realized with respect to the multipath and the C/N ratio as shown in FIG. 151. As described previously, it is possible to combine the CSW-OFDM and the C-CDM of the present invention for preventing the overall transmission efficiency from being lowered. In the first, 1-2, and 1-3 layers 801a, 851a, and 851az, the LDTV grade signal can be stably received by, for example, the vehicle TV receiver subjected to the large multipath T_M and low C/N ratio. In the second and 2-3 layers 801b and 851b, the standard-resolution SDTV grade signal can be received by the fixed or stationary station located, for example, in the fringe of the service area which is generally subjected to the lower C/N ratio and ghost. In the third layer 801c which occupies more than half of the service area, the HDTV grade signal can be received since the C/N ratio is high and the ghost is less because

of large direct wave. In this manner, a two-dimensional multi-layer broadcast service effective to both the C/N ratio and the multipath can be realized by the combination of the GTW-OFDM and the C-CDM or the combination of the GTW-OFDM and the CSW-C-CDM in accordance with the present invention. [thus] Thus, the present invention realizes a two-dimensional, matrix type, multi-layer signal transmission system effective to both the C/N ratio and the 194 multipath, which has not ever been realized by the prior art technologies.

Please amend the paragraph beginning in Column 80, line 66 as follows:

A timing chart of a three level (HDTV, SDTV, LDTV) television signal in a two-dimensional multilevel broadcast of three C/N levels and three multipath levels is shown in FIG. 152. As shown in the figure, the LDTV signal is positioned in slot 796a1 of the first level of [level] layer A, the level with the greatest resistance to multipath interference; the SDTV synchronization signal, address signal, and other important high priority signals are positioned in slot 796a2, which has the next greatest resistance to multipath interference, and slot 796b1, which has strong resistance to C/N deterioration. The SDTV common signal, i.e., low priority signals, and HDTV high priority signals are positioned in levels 2 and 3 of level B. SDTV, EDTV, HDTV, and other high frequency component television signals are positioned in levels 1, 2, and 3 of level C.

Please amend the paragraph beginning in Column 81, line 55 as follows:

Block diagrams of a specific ECC encoder 744j and a specific ECC decoder [749j] 759j are shown in FIG. 160a and FIG. 160b, respectively. FIG. 167 is a block diagram of the deinterleaver 936b. The interleave table 954 processed in the deinterleave RAM 936a of the deinterleaver 936b is shown in FIG. 168a, and interleave distance L1 is shown in FIG. 168b.

Please amend the paragraph beginning in Column 82, line 23 as follows:

The present invention will be advantageous for use with a satellite or terrestrial broadcast service which is essential to run in the same standards for as long as 50 years. During the service period, the broadcast standards must not be altered but improvements will be provided time to time